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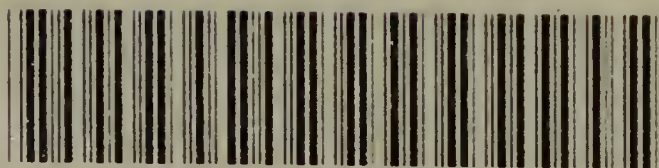
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*March, 1878.*



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THE



# CHEMICAL NEWS

AND

JOURNAL OF PHYSICAL SCIENCE.

WITH WHICH IS INCORPORATED THE "CHEMICAL GAZETTE."

*A Journal of Practical Chemistry*

IN ALL ITS APPLICATIONS TO

PHARMACY, ARTS, AND MANUFACTURES.

EDITED BY

*WILLIAM CROOKES, F.R.S., &c.*

VOLUME XXXVI.—1877.

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# THE CHEMICAL NEWS.

VOLUME XXXVI.

EDITED BY WILLIAM CROOKES, F.R.S., &c.

No. 919.—JULY 6, 1877.

## ON REPULSION RESULTING FROM RADIATION.—PART III.\*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from vol. xxxv., p. 268.)

163. THESE experiments had all been tried with surfaces made of pith, a very bad conductor of heat. It became of interest to ascertain what would be the action of a radiometer the fly of which was made of a good conductor, such as a metal. Experiments already recorded show that metals behave generally like pith. This has been proved in the case of magnesium (99, 100), aluminium (122), silver and bismuth (63), copper (64), brass (37—40, 61), and platinum (55, 62, 113, 114, 115); but none of these experiments have been tried under the different conditions to which I have lately submitted the radiometers.

164. I selected thin rolled brass as the material where-with to make the fly of a radiometer. The parts were all fastened together with hard solder, and no cement or organic matter was used, so that if necessary the radiometer could be submitted to a high temperature without injury. In general appearance when finished it resembles the instrument shown in fig. 6. The moving portion weighed 13.1 grains. One side of the disks was silvered and polished, the other side being coated with lampblack. The apparatus was exhausted with a charcoal reservoir attached. When exhausted it proved to be very sensitive, considering its weight, a candle  $1\frac{1}{2}$  inch from the bulb causing it to revolve about once a second, the black surface being repelled in the normal manner.

165. The apparatus, standing motionless in a rather dark cold room, was covered with a warm glass shade. It immediately commenced to revolve the negative way, viz., silver side repelled, but very slowly.

A few drops of ether poured on the bulb caused the arms to move rather rapidly the normal way. A hot shade put over whilst it was thus moving caused it to stop, and then begin moving the negative way.

A small non-luminous gas-flame was held vertically beneath the apparatus, so that hot air should ascend and wrap round the bulb on all sides. The arms now revolved the negative way.

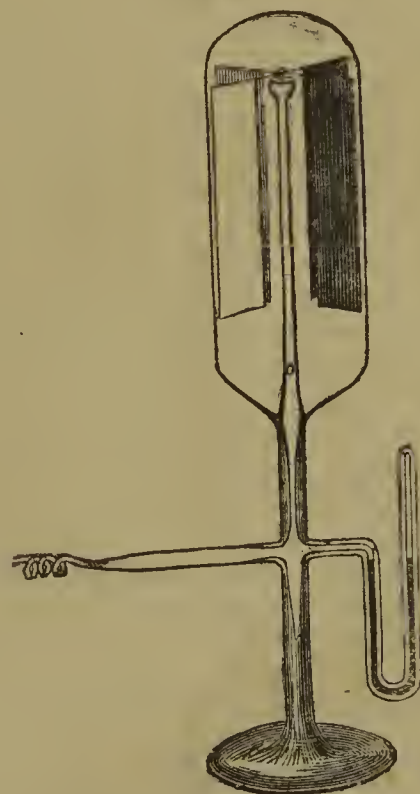
166. The brass radiometer being somewhat heavy, one was made of aluminium, of the shape represented in fig. 9. The surfaces were made large, and the whole moving parts were hard-soldered together. A siphon-gauge was attached, and the apparatus was connected

direct on to the pump by a spiral, no charcoal-tube being used. One side of the wings was bright aluminium and the other was lampblack. When exhausted the fly revolved very quickly to a candle a few inches off, the black being repelled.

167. On removing the candle a remarkable phenomenon was observed. The arms stopped and immediately commenced revolving the negative way, keeping up rotation for more than ten minutes, and being little inferior in speed to what it was when the candle shone on it.

The whole of the bulb was heated with a Bunsen burner; whilst it was getting hot the aluminium arms revolved rapidly in the normal direction; but as soon as the source of heat was removed and cooling commenced, negative rotation set up, and continued with great energy till the whole thing was cold. It appeared as if the negative movement during cooling was equal in amount to the positive movement as it was being heated.

FIG. 9.



168. The very sensitive pith radiometer used in experiments 152 *et seq.* was now experimented with. A little ether was dropped on the bulb as it was standing still in a faint light. The evaporation of the ether caused a chilling of the instrument and a rapid abstraction of heat from the fly. It commenced to move in the positive direction, and increased quickly in speed until it revolved at a rate of one in four seconds. This movement kept

\* A Paper communicated to the Royal Society, January 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

up for several minutes, and as it slackened it could at any time be revived by a few drops of ether on the bulb.

When in rapid positive movement, produced in the above manner, a hot glass shade (161, 165) was placed over the radiometer. The movement slackened, the arms quickly came to rest, and then immediately revolved in the negative direction, acquiring a speed of about two revolutions a minute, and keeping up this negative movement for more than ten minutes.

169. The radiometer was again set in rapid positive rotation by dropping ether on the top of the bulb. I applied the tip of one finger to the side of the bulb for ten seconds. The rotation stopped, and I could not start it again for some minutes, although I dropped ether on the bulb, several times in the interval.

When the radiometer had once more acquired the temperature of the air, I dropped ether on the bulb, not in the centre, but so that the ether wetted only half of the bulb. The arm which was nearest to the part most wetted by the ether rushed towards that part and remained, as it were, fixed opposite to it, refusing to move away, although I tried to equalise the temperature by dropping ether on the other parts of the bulb, and to drive it round by bringing a candle near. Not until the candle came within 6 inches of the bulb did the arms begin to rotate, which they then did with a rush, as if suddenly relieved from a state of tension.

170. These results appear at first sight anomalous. I think, however, they admit of an explanation which is in keeping with the facts, if I may make one supposition. The great difference between a lampblack and a white surface is only an optical one. Pith reflects a considerable amount of light, and lampblack absorbs a large quantity of light, but it is unsafe to carry the analogy into the ultra-red region of the spectrum. We know of many white powders, optically identical, which in their thermic relations are as wide apart as pith and lampblack (*e.g.*, powdered alum and powdered rock-salt); and it is therefore reasonable to suppose that other substances may exist which, whilst they are very different to the eye, may have the same action on dark radiant heat. We may also fairly assume that a substance may exert a considerable selection on the rays which it absorbs and reflects—that, in fact, there may be, in the ultra-red region of the spectrum, *thermic* colours, as in the visible spectrum we have *optical* colours; so that whilst two substances may absorb to the same extent heat-rays of one refrangibility, they may be quite different in their actions on heat-rays of another refrangibility. These suppositions are not only reasonable but very probable: let us see how they account for the facts. Light falls on the black and white surfaces of a radiometer, or other similar instrument. That which falls on the white surface is nearly all reflected back again. Were the surface perfectly white *all* the force which went into the bulb would be reflected out again; the incident ray would contain in itself a certain amount of potential work; but as the emergent beam would come out with no loss of intensity, no work could have been done on the reflecting surface. In practice this does not quite hold good. Pith is not a perfect reflector, some light stops behind, that which comes from it is not quite equal to that which it receives, and the balance makes itself evident by causing the pith to move to a slight extent.

171. But in the case of light falling on the lampblack surface the result is very different. Here, practically, the whole of the light is quenched by the lampblack. Force is poured into the bulb, but none comes out. What, then, becomes of it? It is changed into motion, and becomes evident in the strong repulsion which is exerted on the black surface.

This I think is clear in the case of light. We can see that there is an enormous difference in the absorbing powers of white and black pith for light, and we can also see that there is an equally marked difference between the motive power which light exerts on them. But with the

heat from boiling water or from a hot copper ball our eyes cannot tell us whether the same difference obtains or not, and we must use other and less direct means of finding out what takes place.

Let me direct attention to the experiments described in paragraphs 128 and 144. Here red-hot copper was seen to repel the black surface with violence, and the white surface only moderately. As the copper ball cooled, the repulsion on each surface became more nearly equal. At 400° C. the differential action was decided, though faint. At 300° C. the black surface was still repelled slightly more than the white surface, but at 250° C. down to 100° C. the repellent action of the radiant heat was the same on the white as on the black surface. The two surfaces were then *thermically* of the same colour.

The fact that the work done on each surface was equal, is, I think, proof that the absorption of the incident rays was equal.

(To be continued.)

## ON PUTRESCENT ORGANIC MATTER IN POTABLE WATER.\*

By GUSTAV BISCHOF.

It is indeed fortunate that the smell and taste are generally extremely sensitive indicators of putrefaction in articles of food. This does not, however, apply to drinking water, which may be largely polluted by putrescent organic impurities without causing any suspicion to our senses. And yet the question of the wholesomeness of water hinges mainly upon the presence or absence of such putrescent matters, as they themselves are the cause of derangements of the human system. Most serious, however, are the consequences when those low forms of organic life, which in all probability form the specific poison of cholera, typhoid fever, and other diseases, gain admission to drinking water polluted by putrescent matter.

A number of observations point to the conclusion that these organisms, or their germs, are not infectious as long as surrounded by *fresh* organic matter, but as soon as fermentation sets in they show their poisonous virulence. Thus it has been observed that the discharges of cholera and typhoid patients are not infectious as long as they are fresh, but by putrescence their poisonous character is developed.

Chemical analysis is incapable of discriminating between living or dead, fresh or putrescent organic matters. The microscope reveals their nature more fully; but it is nevertheless frequently a matter of great difficulty to decide as to the existence or non-existence of *bacteria* of putrefaction, or their germs, in water. It thus appeared to me that this information might, in some cases at least, be gained with greater certainty by an indirect method.

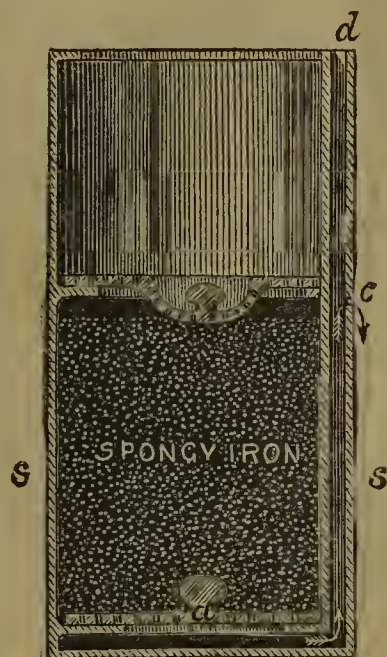
If we want to determine whether a gas be carbonic anhydride, we pass it through potash bulbs, and see whether these increase in weight. Similarly the presence or absence of putrefactive agencies in water may be determined by their action upon organic matter. The test I selected is fresh meat, as the slightest putrescent changes in it can most readily be detected by its smell.

The experiments, which were originally made with a view of determining the improvement of water by certain filtering media, were, with the exception of experiment VIII., carried out in the following manner:—

On to the perforated bottom (*a*) of a stoneware vessel (*s s*) I place some fresh meat. The vessel is then filled to about two-thirds with the materials to be experimented upon, and lastly with water. Into opening *c* a tin tube is fixed, which is first bent upwards and then downwards in the shape of an inverted U, to prevent any *bacteria* or their germs from passing through this outlet-tube into the bottom of the vessel. The air-pipe *d*, down to *c*, is

\* Read before the Royal Society April 19, 1877.

filled with firmly compressed cotton-wool, and a glass tube, sealed at the bottom, passed down through the material experimented upon, to allow of the temperature being measured in close proximity to the meat. The vessels thus prepared are immersed in a boiler filled with cold water, which is gradually heated and kept boiling for several hours. The object of this is to destroy any germs adhering to the meat. The temperature at the bottom of the sealed glass tube was, during the boiling, in each of the following experiments 93-95° C.



After cooling, the Chelsea Company's water was constantly passed through the vessels in the direction indicated by arrows, at as nearly as possible a uniform speed.

It is thus evident that any *bacteria* of putrefaction, or their germs, in the water would, after a time, render the meat putrid, or, if it remains fresh, they must have been absent, or at least inactive, when the water reached the meat.

I now proceed to describe the experiments:—

*Experiment I.*—One of the vessels was filled with spongy (metallic) iron, and treated as before described; after a fortnight the meat was perfectly fresh.

*Experiment II.*—A vessel filled with animal charcoal; after a fortnight the meat showed strong evidence of incipient putrefaction. As experiments I. and II. were conducted side by side, this result proves that the preservation of the meat in Experiment I. was not due to any external cause, such as the low temperature then prevailing.

*Experiment III.*—Water continuously passed through a vessel filled with spongy iron for four weeks; even then the meat was perfectly fresh and hard.

*Experiment IV.* was a repetition of II., the filtration of water through animal charcoal being continued for four weeks. The meat was soft and quite putrid. In the course of this experiment the exit-tube was several times choked by mucous matter.

*Experiment V.*—In Experiments I. and III. with spongy iron, this material was employed without separating any of the fine dust. In order to ascertain whether *bacteria* were merely mechanically retained, a vessel was charged with spongy iron, from which all the finer particles had been separated by a sieve with thirty holes on the linear inch. The filtering medium in this case was therefore of a porous nature. After four weeks' filtration the meat was found perfectly fresh.

*Experiment VI.*—In the previous experiments with spongy iron the meat was in contact with water, from which the iron in solution had not been separated. With a view of ascertaining whether the iron in solution was the preserving agent, a stoneware vessel was charged underneath the spongy iron with pyrolusite and sand, so as to abstract the iron from the water before it came in contact with the meat. After four weeks' filtration the latter was found perfectly fresh.

*Experiment VII.*—By a separate experiment I ascertained that the oxygen is completely abstracted from water

during its passage through spongy iron. In order to determine whether the absence of oxygen be the cause of the preservation of the meat, and whether the *bacteria* or their germs be killed or can be revived when supplied with oxygen, an evaporating basin was inverted over the meat. This must have retained a quantity of air in its cavity, the air being gradually dissolved by the water in close proximity to the meat. After four weeks' filtration the meat was perfectly fresh; I succeeded in collecting a small bubble of the gas, still in the cavity of the evaporating basin. This was quite free from oxygen.

It is therefore doubtful whether oxygen was supplied to the water sufficiently long to justify any conclusions from this experiment. However, the result of Experiment VIII. rendered a repetition unnecessary.

*Experiment VIII.*—Fresh meat was placed at the bottom of a glass vessel and left standing, covered with about four inches of spongy iron and water. The vessel in this instance was *not* boiled. After three weeks the meat was very bad, demonstrating that the action of the *bacteria* of putrefaction adhering to the meat was not prevented by the spongy iron above, and if, during the previous experiments with spongy iron, agencies capable of causing putrefaction had at any time come in contact with the meat—in other words, if the *bacteria* had not been killed in their passage through spongy iron,—the meat must, as in this last experiment, have shown marks of their action. It therefore appears that *bacteria* are permanently rendered harmless when passing in water through spongy iron. This conclusion is further corroborated by the observation that even effluent sewage-water, after passing through the spongy material, has remained perfectly bright for now five years, when exposed to light in a half-filled stoppered bottle.

I believe that the action of spongy iron on organic matter largely consists in a reduction of ferric hydrate by organic impurities in water. We know that even such organic matter as straw or branches is capable of reducing ferric to ferrous hydrate. We know that even such indestructible organic matter as linen and cotton fibres is gradually destroyed by rust stains. This action is slow when experimenting upon ordinary ferric hydrate, but it may, *in statu nascendi*, be very energetic—the more so, if we consider the nature of the organic matter in water. Ferric hydrate is always formed in the upper part of a layer of spongy iron, when water is passed through that material. The ferrous hydrate resulting from the reduction by organic matter may be re-oxidised by oxygen dissolved in the water, and thus the two reactions repeat themselves. This would explain why the action of spongy iron continues so long.

It is, however, quite certain that there is also a reducing action taking place when ordinary water is passed through spongy iron. This is clearly indicated by the reduction of nitrates.

Our knowledge of those low organisms which are believed to be the cause of certain epidemics is as yet too limited to allow of direct experiments upon them. It is not improbable that, like the *bacteria* of putrefaction, they are rendered harmless when water containing them passes through spongy iron; but until we possess the means of isolating these organisms, this question can only be definitively settled by practical experience. Should this not be satisfactory, should those specific contagia not be destroyed when passing in water through spongy iron, then the separation of *bacteria* by spongy iron may afford means of isolating those germs of disease, should it be favourable; then we shall have found in spongy iron the material to prevent the spreading of epidemics by potable water.

**Action of Salicylic Acid in Typhoid Fever.**—Dr. Albert Robin.—In typhoid fever the internal use of salicylic acid reduces the quantity of urine and increases its specific gravity. In health the very opposite is the case. —*Moniteur Scientifique*.

## ON THE NEW METAL DAVYUM.

(PRELIMINARY NOTICE.)

By SERGIUS KERN, St. Petersburg.

ON the 28th of June, in the residues obtained after the treatment of platinum ores in order to separate the metals of the platinum group, I perceived the presence of a new metal belonging to the platinum group, which has been called by me "Davyum," in honour of the great English chemist Sir Humphry Davy.

The ores under examination had the following average composition:—

	Per cent.
Platinum .. .. .	80.03
Iridium .. .. .	9.15
Rhodium .. .. .	0.61
Osmium .. .. .	1.35
Palladium .. .. .	1.20
Iron .. .. .	6.45
Ruthenium .. .. .	0.28
Copper .. .. .	1.02
	100.09

This ore was treated by the well-known analytical process of Prof. Bunsen, and in the separation of rhodium and iridium the presence of Davyum was detected. The precipitate by the action of hydrogen at 100° (impure mixture of rhodium and iridium) was purified by dissolving it in aqua regia. Next it was treated by chlorine in the presence of barium chloride. Water was added, the barium was precipitated and filtered away, and the rhodium and iridium solutions were mixed with a concentrated solution of hydrogen sodium sulphite ( $\text{HNaSO}_3$ ).

In some days a precipitate of a light yellow colour was obtained, which was the double sulphite salt of rhodium. The precipitate was filtered off, and the filtrate was heated on a sand-bath in order to obtain the iridium double salt which falls down. The solution from this filtrate, collected from the treatment of 600 grms. of the platinum ore, was concentrated and heated with ammonium chloride and ammonium nitrate in excess, for one hour, at the temperature 60° to 65°. A dark red precipitate was obtained, which on ignition gave a grey spongy mass, and when fused by means of the oxy-hydrogen blowpipe, gave a silvery ingot of Davyum. The weight of the ingot was 0.27 gm.

The metal Davyum dissolves readily in aqua regia. In boiling sulphuric acid the metal dissolves very difficultly. Potassium hydroxide gives a precipitate of a light yellow colour. Sulphuretted hydrogen in acid liquids gives a brownish precipitate, which quickly turns black on being dried. It is a very curious fact that a diluted solution of Davyum chloride with potassium sulphocyanide gives a red colouration identical with the colouration produced by mixing solutions of potassium sulphocyanide with ferric salts. If a concentrated solution of Davyum chloride is mixed with potassium sulphocyanide a red precipitate is thrown down on gently heating the solution.

The specific gravity of the metal Davyum was found to be 9.385 at 25° Celsius. Davyum is extremely infusible, hard, and to some extent ductile.

The new metal may be supposed to occupy the place between molybdenum and ruthenium in the periodical system of elements proposed by Prof. Demetrius Mendeleeff (*Annalen d. Chemie und Pharmacie*, Suppl. B, viii., p. 133; *ibid.*, p. 168). Perhaps Davyum is the hypothetical metal in the periodical system having the atomic weight equal to 100.

The author expects in some months to study more closely the physical and chemical properties of the metal Davyum (Da).

Obouchoff Steel Works.

## REPORT

ON THE

DEVELOPMENT OF THE CHEMICAL ARTS  
DURING THE LAST TEN YEARS.\*

By Dr. A. W. HOFMANN.

(Continued from vol. xxxv., p. 228.)

*Manufacture of Sulphuric Acid.* By ROBERT HASENCLEVER, Manager of the Stolberg Works.

*Purification of Sulphuric Acid.*—The sulphuric acid of commerce generally contains small quantities of lead, iron, and arsenic, besides traces of selenium and thallium. It is only in some few of the arts that a pure acid is required on the large scale, *e.g.*, in the preparation of sulphate of soda free from iron for the plate-glass manufacture. In most cases the iron and lead present in sulphuric acid do not interfere with its applications, and it can be freed from them, if needful, by simple distillation.

The removal of the arsenic is of greater importance, and for this purpose various methods have been proposed. H. A. Smith, in his work already quoted, has given detailed researches on the amount of arsenic acid in sulphur ores. He found in pyrites from:—

	Per cent Arsenic.
Spain { Tharsis .. .. .	1.651
{ Mason .. .. .	1.745
Belgium.. .. .	0.943
Westphalia .. .. .	1.878
Norway.. .. .	1.649
Do. rich in sulphur .. .. .	1.708

On roasting a part of the arsenic remains in the burnt ore; a part is deposited in the flues leading to the chambers; a further portion arrives into the acid, and passes along with this into the various products prepared with its aid, and is finally found in the sulphur recovered from alkali waste. According to Smith there is present in:—

	Per cent Arsenic.
Norwegian pyrites (hard kind) ..	1.649
Do. burnt .. .. .	0.469
Sulphuric acid .. .. .	1.051
Flue dust before entering chambers	46.360
Chamber mud .. .. .	1.857
Hydrochloric acid .. .. .	0.691
Salt-cake .. .. .	0.029
Alkali waste after lixiviation .. ..	0.442
Soda .. .. .	0.000
Regenerated sulphur.. .. .	0.700

As to the removal of arsenic from sulphuric acid several important observations have been made in the last few years. Bussey and Buignet† have examined the customary methods for the removal of this impurity, and pronounce them insufficient. The precipitation of the arsenic by means of sulphuretted hydrogen or barium sulphide is not complete, and the use of these means involves a considerable dilution of the acid. If we attempt to purify an impure acid by distillation we obtain, under certain circumstances, a product free from arsenic, but in most cases an arseniferous acid passes over. Bussy and Buignet have ascertained the conditions in which a pure acid is obtained. They found that sulphuric acid containing arsenic in the form of arsenic acid can be purified by distillation, but not such as contains arsenious acid. Arsenic acid remains entirely in the residue, whilst arsenious acid passes over. Hence, Bussy and Buignet recommend to treat the commercial acid, which generally contains both arsenious and arsenic acid, with nitric acid, in order to peroxidise the arsenious acid. The acid is

\* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

† Bussy and Buignet, *Dingl. Pol. Journ.*, clxii., 454.

then mixed with a little sulphate of ammonia in order to destroy nitrous acid, and distilled.

Bückner\* has modified his original process for the removal of arsenic, which consisted in heating the sulphuric acid with hydrochloric acid. He has perceived that arsenic, when present in crude sulphuric acid as arsenic acid, cannot be removed by hydrochloric acid. To convert arsenic acid into arsenious acid the crude acid to be purified must either be first heated with charcoal and then treated with hydrochloric acid, or the heating with charcoal and the treatment with hydrochloric acid are conducted simultaneously. As experience proves that the acid in most cases contains arsenic acid the treatment with charcoal is to be recommended in all cases.

Blondlot† converts the arsenious acid into arsenic acid prior to distillation not by nitric acid but by manganese peroxide or the manganate of potash.

Lyte‡ proposes to heat the raw acid first to  $110^{\circ}$  in a bowl with  $\frac{1}{4}$  to  $\frac{1}{2}$  per cent sulphuric acid, then to mix with chromate of potash, and finally to distil. The oxalic acid removes nitrous acid, and the chromic acid converts the arsenious acid into arsenic acid.

At Freiberg and Oker sulphuric acid is purified by sulphuretted hydrogen, and this process is particularly recommended as the gas is not conducted into the liquid. The sulphuric acid is allowed to flow down a precipitating tower, fitted with prisms like a Gerstenhöfer furnace, but made of lead and so arranged that an angle is always upwards and a side downwards. Into this tower enters from below a current of sulphuretted hydrogen evolved from green pyrites and sulphuric acid. As the acid flows down in thin layers the precipitation of the arsenic sulphide is very satisfactory.

*Concentration of Sulphuric Acid.*—The kinds of apparatus generally employed in sulphuric acid works for concentrating the chamber acid are:—

1. Evaporation in leaden pans, standing upon cast-iron plates heated by the direct action of fire beneath the plates.
2. The action of a reverberatory fire upon leaden pans, the edges of which have double sides and can be cooled by a current of water in order to prevent the lead from melting. Or the concentration is effected,
3. By steam.
4. By hot sulphurous acid.

In the application of the first-mentioned arrangement for concentration (open pans with direct fire) the author considers it advisable|| to regulate the evaporation by the thermometer, as the lead is readily destroyed at a too elevated temperature.

At the commencement of the treatise just quoted the author enters into an examination of the action of sulphuric acid upon lead, and states as the result of his observations that perfectly pure lead is more attacked during the concentration of sulphuric acid than a less pure metal. The same observation had been already made by Calvert and Johnson.§

If the open pans employed in the evaporation are not made of too soft a lead they last for a long time, at least if the concentration is conducted with due care.

Chandon makes the judicious suggestion that the fire-gases from every arrangement for the concentration of sulphuric acid should be passed into a small separate chimney, since it is not possible to determine if a loss of acid is taking place when steam, hydrochloric acid gas, and the volatile products of the furnaces of a chemical works are all led into one large chimney.

The ordinary concentration in open pans is simple, and is still, therefore, principally in use, though not greatly to be recommended as far as repairs, consumption of fuel, and loss of acid are concerned.

The apparatus in which the flame plays directly over the surface of the acid was at one time widely used in England, and was first introduced into Germany at the Lüneburg Chemical Works. The furnaces last a long time without repairs, and consume little fuel, but are liable to the defect that an excessive temperature is often produced when considerable quantities of sulphuric acid escape along with the products of combustion. On this account such furnaces have been abandoned in many places where they had been introduced.

The idea of concentrating sulphuric acid by the indirect action of steam dates from the year 1865 and is due to Carlier, the manager of the Duisburg Chemical Works. After various experiments tried in this establishment the evaporation, according to the report of F. Curtius, is conducted in wooden chests lined with lead, 4 metres in length and breadth. At the bottom of each chest are two leaden worms, each 45 metres in length, 3 centimetres in width inside, and 7 millimetres in thickness of metal. In order that the condensed water may flow off easily from the pipes the bottom has the form of a blunted pyramid, the receptacle being 0.60 metre high in the middle, and only 0.3 at the ends. Both ends of the piping are in connection with the steam boiler, and can be shut off by means of cocks. The boiler is fixed lower than the concentration chests, which receive their supply of steam from a pipe leading from the dome. The pipes which allow the escape of the steam from the condensation chest slope towards the steam space in the boiler, so as to permit a reflux of the condensed water into the latter. The action is intermittent. The chest is charged with acid at 1.5 sp. gr., and heated by steam till the sp. gr. rises to 1.7. The entire contents of the chest are then run into a wooden cistern lined with lead. In this reservoir there is a worm through which the chamber acid must pass on its way to the concentration chest, so that the latter is always fed with acid already warmed. The pressure of steam in the boiler amounts to three atmospheres, and an apparatus of the size given yields in twenty-four hours 5000 kilos. of acid at sp. gr. 1.7. The consumption of coal is 9 kilos. per every 100 kilos. of concentrated acid. The waste of lead amounts to 0.2 kilo. per ton of acid. The boiler only requires to be supplied with water to compensate for the escape through faulty joints. It is recommended to fence in the concentration chest with a wooden screen to prevent the workmen from being injured by the hot acid scattered abroad if a steam pipe should burst.

Delplace observed at the Stolberg Works that the leaden steam pipes are principally attacked just where they plunge into the acid. The dust, which, even though slight, still gradually accumulates upon the pipes, causes by its capillary attraction the sulphuric acid to rise a few centimetres above the level of the liquid in the pan. This acid is quickly concentrated by the steam, and thus rapidly occasions a strong corrosion of the lead. To meet this defect at the place where the pipe plunges into the acid a leaden bell is blown on, opening upwards, and of rather larger diameter than the pipe itself. The outer leaden surface of the bell is still coated with a thin damp layer of dust, but which is no longer heated by the steam.

Concentration by steam has been of late years widely adopted. No sulphuric acid is lost on account of the low temperature employed, and the process has the further advantages of cleanliness, of a very small consumption of coal, and of an important saving of labour.

(To be continued.)

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*Extraction of Arsenic from Magenta Residues.*—M. Cl. Winckler's process consists in supersaturating with soda the mother-liquors from the purification of magenta contained in the crude product as arseniate of rosanilin, and on the reduction of the arseniate of soda by charcoal in presence of carbonate of lime.—*Chemisches Centralblatt*, vii., p. 651.

\* Bückner, *Bayer Kunst. u. Gewerb.*, 1864, 480.

† Blondlot, *Comptes Rendus*, lviii., 76.

‡ Lyte, *CHEM. NEWS*, x., 172.

|| Hasenclever, *Ber. Chem. Ges.*, vi., 502.

§ Calvert and Johnson, *Comptes Rendus*, lvi., 140; *Dingl. Pol. Journ.*, 1863, 358.

ON THE  
ABSORPTION OF ANTIMONY AND ARSENIC  
FROM A SOLUTION OF THEIR OXIDES  
IN HYDROCHLORIC ACID BY CHARCOAL.\*

By WILLIAM SKEY,  
Analyst to the Geological Survey of New Zealand.

SOME time back I showed† that charcoal, when freshly made or ignited, absorbs, from their aqueous or acid solutions, several substances not before known as being affected in this manner, and I proposed to apply this reaction to the purification of certain of our chemical reagents from substances difficult or tedious to remove by the processes now in use for this purpose.

Since then I have made further investigations in this direction, and find that antimony and arsenic can be so largely removed from solutions of their oxides or chlorides in moderately strong hydrochloric acid (with a little tartaric acid in the case of antimony) by fresh charcoal, that neither of them can be detected therein by Reinsch's test, although before such process was applied both were abundantly evidenced to the test named.

Thus commercial sulphuric and hydrochloric acids diluted with a little water can be purified from either of these substances by agitating them intermittently for a short time with fresh charcoal, and then filtering off; application of heat to the mixture expedites this result.

The charcoal used does not appear to give up any portion of either the antimony or arsenic when digested with aqueous solution of potash, hence I consider it very probable that it would absorb either of these metals from alkaline solutions also. Such charcoal, however, when placed in voltaic contact with pure zinc in hydrochloric acid, evolves antimoniuiretted or arseniuiretted hydrogen (as the case may be) very perceptibly, and it can be wholly divested of either of these substances, when treated in this manner.

In connection with this evolution of such hydrides from charcoal under the circumstances just stated, I will observe here that sulphur, when absorbed by charcoal, is as I have already shown,‡ also given off, and as a hydride, when the charcoal containing it is connected voltaically with zinc in suitable acids, whereas hot aqueous solutions of potash do not seem to dissolve this sulphur. It appears, therefore, that the character of the absorption of sulphur by charcoal is the same as that of the absorption of antimony and arsenic by this substance.

In examining for minute quantities of either antimony or arsenic by Reinsch's or Marsh's test, I would recommend that the acids used for this (even though purporting to be free from these metals) be filtered through fresh charcoal just before using them, as they frequently extract small quantities of these impurities from the bottles in which they are stored.

## PROCEEDINGS OF SOCIETIES.

### ROYAL SOCIETY OF EDINBURGH.

June 4, 1877.

MR. J. Y. BUCHANAN, Chemist of the *Challenger* Expedition, read a paper on "*Air Dissolved in Sea-Water.*" He showed the water-bottle which he invented, and which was used for collecting the "intermediate waters." It consists of a metal cylinder with tap at each end, connected by a metal rod bearing a flap, which falls into position when the bottle ceases to descend and is being "hove in;" the pressure of the water rushing past it causes it to descend and shut the taps, thus enclosing the

desired sample of water. The apparatus for boiling out the oxygen and nitrogen, and that for determining the carbonic acid, were illustrated by diagrams, which also afforded an idea of the arrangements inside the miniature laboratory on board the *Challenger*. The general results of investigations made went to show that while the absolute amount of oxygen and nitrogen capable of being dissolved is less in the case of sea-water than in that of fresh water, the proportion between the amounts of the two gases dissolved remains nearly the same; that the absolute amount dissolved both of permanent gas and of carbonic acid depends on the temperature; that in no case is there more gas dissolved in water taken from any depth than it would be capable of absorbing from the atmosphere in regions where the same temperature prevails at the surface; that, in fact, the water at great depths preserves all the physical properties which it had when it left the surface, including temperature, specific gravity, and gaseous contents (with the exception of the proportion of oxygen). The belief in the existence of water at great depths so charged with gas as to effervesce when brought to the surface is not wholly false. This phenomenon is observed when water is brought from great depths in the hot equatorial and tropical regions. Near the bottom the water may have a temperature bordering on the freezing-point, and will contain a corresponding amount of air. Brought to the surface, where the temperature may be between 80° and 90° F., it can no longer contain the same amount of gas; and if in a glass vessel, the walls will be seen to clothe themselves with minute air-bells, somewhat like natural Seltzer water which has stood for a little time in an open vessel. At the surface the percentage of oxygen varies between 33 and 35 per cent, the higher number having been observed in a water collected almost on the Antarctic circle; the smallest percentages have been found in the Trade-wind districts. In bottom waters the absolute amount is greatest in Antarctic regions, and diminishes generally towards the north. The oxygen percentage is greatest over "diatomaceous oozes," and least over "red clays" with peroxide of manganese, and over "blue muds" it is greater than over "globigerina oozes." In intermediate waters the very remarkable fact was observed that the oxygen diminishes down to a depth of 300 fathoms, where it attains a minimum, after which it rises. The following figures will show the nature of this phenomenon:—

Depth (fathoms)	..	0	25	50	100	200	300	400	800	{ Between 800 and bottom.
Oxygen (N+O=100)		33.7	33.4	32.3	30.2	23.4	11.4	15.5	22.6	23.5

It is evident from these figures that between 200 and 400 fathoms there is a great consumption of oxygen going on, and, as it is difficult to conceive its being consumed otherwise than by living creatures, the conclusion is forced on us that animal life must be particularly abundant and active at this depth, or at least more abundant than at greater depths; for at less depths there is more opportunity of renewal of the oxygen, by reason both of the greater proximity to the surface and of the existence of vegetable life. This conclusion was borne out by the numerous experiments made by Mr. Murray with the tow-net at intermediate depths, which went to prove the existence of abundance of animal life down to 400 fathoms, vegetable life never extending to much below 100 fathoms. Below 400 fathoms life is sparingly met with.

### DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

June 25th, 1877.

Prof. A. W. HOFMANN, F.R.S., Vice-President, in the Chair.

Dr. R. BIEDERMANN and Dr. S. GABRIEL have investigated the cause of "*The Red Spots on Yellow Bricks,*" and finds that they are not due to the presence of  $\text{Fe}_2\text{O}_3$ , but

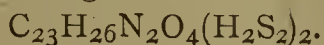
\* Read before the Wellington Philosophical Society, January 29th, 1876.

† CHEMICAL NEWS, March 27, 1868.

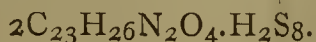
‡ CHEMICAL NEWS, vol. xxvii., p. 216.

to sulphuric acid. Analyses of the red portions of the bricks, and of the main mass, showed respectively 11.10 and 0.80 per cent  $\text{SO}_3$ . These spots result only when coal is used for fuel, the  $\text{SO}_2$  vapours uniting with aqueous vapours and being confined by the  $\text{CaO}$  in the clay.

Prof. A. W. HOFMANN presented a second communication "On the Polysulph-hydrates of the Alkaloids" (CHEMICAL NEWS, xxxv., p. 240). Attempts had been made without result to prepare polysulphides analogous to the polyiodides, similar, for instance, to the iodine derivatives of tetra-methyl-ammonium. Even methyl-strychnine yielded no polysulphide by the action of  $(\text{NH}_4)_2\text{S}$ , as is the case with strychnine itself. On the contrary, it was found that other alkaloids yielded polysulphides when the conditions of the reaction were changed. A hot solution of brucine gave upon addition of  $(\text{NH}_4)_2\text{S}$  a compound identical with that obtained by Schmidt through the action of air and  $\text{H}_2\text{S}$  on brucine, to which the latter assigned the formula—



The analysis of this body with  $\text{As}_2\text{O}_3$  shows, however, that  $\text{H}_2\text{S}_8$  is contained in it, and that the formula is—



It decomposes like the analogous strychnine compound under the formation of an oily substance, showing the general properties of persulphide of hydrogen. Reference was made to the investigations by Ramsay on this subject, who prepared a polysulphide the analysis of which ranged between the limits  $\text{H}_2\text{S}_7$  and  $\text{H}_2\text{S}_{10}$ .

Prof. HOFMANN exhibited also an ingenious contrivance for the "Rapid Preparation of Formic Aldehyd." It consists essentially of a platinum tube containing platinum wire, through which air laden with the vapours of methyl-alcohol passes. The arrangement is such that the heat generated by the formation of the aldehyd is used to prevent the fall of temperature in the supply of  $\text{CH}_4\text{O}$  consequent upon the rapid evaporation. The simplicity of the construction, as well as the rapidity and ease with which the operation is conducted, will render it convenient for the preparation, not only of other aldehyds, but also of many other bodies.

The following communications have been received from non-resident members:—

R. SCHIFF, "Derivatives of Furfurine and Furfuramide." Both of these compounds yield with nitrous acid an interesting series of compounds. Furfurine is not attacked by nascent hydrogen or mustard oils. It forms, however, a well defined acetyl compound, and a hexabromo-acetyl-furfurine has been prepared, which the author regards as consonant with the assumption of a quadrilateral union of carbon atoms in the molecule.

A. ATTERBERG has examined the crude "Wood-Spirit from Norwegian Pines," and found in the higher boiling portions, besides australine and another known homologue, a new turpentine, to which he assigns the name *sylvestrine*.

C. ZULKOWSKY, "Constitution of Rosolic Acid." The author prepares rosolic acid (aurin) by the action of  $\text{H}_2\text{SO}_4$  on 1 molecule phenol and 2 molecules cresol. If, then, rosaniline receives the formula—



rosolic acid would be—



C. BÖTTINGER finds a good "Absorbent for Carbon Monoxide" in hydrocyanic acid surrounded by a cooling mixture. Concentrated hydrochloric acid does not mix with the solution. On removal from the cooling mixture a regular stream of  $\text{CO}$  is evolved.

R. S. DALE and C. SCHORLEMMER notice the "Formation of Leucaniline from Rosolic Acid" when heated with alcoholic ammonia at  $150^\circ$ .

A. LADENBURG, "Condensation Products in the Ortho Series." Para-meta-toluylen-diamine and formic acid yields, on being heated together for some time, a base melting at  $100^\circ$ , methenyl-toluylen-diamine— $\text{C}_7\text{H}_6\text{N}_2\text{H} \cdot \text{CH}$ . Ortho-amido-phenol gives, with the same treatment, methenyl-amido-phenol,  $\text{C}_6\text{H}_4\text{O} \cdot \text{N} \cdot \text{CH}$ . Para-meta-toluylen-diamine and phthalic anhydride yield diphthalyl-toluylen-diamine  $\text{C}_7\text{H}_6(\text{NC}_8\text{H}_4\text{O}_2)_2$ . Para-meta-toluylen-diamine forms, with benzaldehyd, dibenzyl-toluylen-diamine,  $\text{C}_7\text{H}_6(\text{N} \cdot \text{C}_7\text{H}_6)_2$ . Other aldehyds appear to form analogous compounds. Ortho-toluidine and formic acid yields formo-toluide,  $\text{C}_7\text{H}_7\text{NH} \cdot \text{CHO}$ , melting at  $57^\circ$ . An isomeric isoformo-ortho-toluide is obtained by distilling oxalic acid and ortho-toluidine. The former compound yields, by long exposure to heat, a base,  $\text{C}_8\text{H}_9\text{N}$ , probably situated between indol and methyl-ortho-toluidine. The author describes also various attempts to prepare indigo synthetically from ortho-toluidine. The hydrochlorate yields, with  $\text{Fe}_2\text{Cl}_6$ , a colouring matter, which he names toluidine blue, but which is in essential characteristics different from indigo. Formo-toluide gives a similar colouring matter. With indol a green colouring matter was obtained.

H. WEIDEL and M. v. SCHMIDT, "Modification of Sauer's Method of Estimating Sulphur." In order to insure a complete decomposition of organic bodies containing sulphur, as well as an entire oxidation of the sulphurous acid formed, the substance so to be analysed is mixed with six times the weight of fused boric acid in a platinum boat, and undergoes combustion in a stream of oxygen in a glass tube containing platinum black. The method is especially advantageous in the analyses of the salts of the higher sulpho acids in the aromatic series.

W. LENZ, in the course of an examination into the influence exerted by the atoms  $\text{Fl}$ ,  $\text{Cl}$ ,  $\text{Br}$ , and  $\text{I}$ , on the character of a para-halogen-benzene-sulphonic acid, examines, first, "Para-iodo-benzene-sulphonic Acid,"  $\text{C}_6\text{H}_4\text{ISO}_3\text{H}$ . The acid was prepared by the action of  $\text{HI}$  on diazo compound derived from sulphanilic acid. A number of salts are described. The author obtains also from this diazo compound with  $\text{HFl}$ , para-fluorobenzene-sulphonic acid,  $\text{C}_6\text{H}_4\text{FlSO}_3\text{H}$ . All of its derivatives, with the exception of the amide, are exceedingly soluble.

H. WEIDEL and M. GRUBER, "Action of Bromine on Tri-amido Phenol in the Presence of Water". This reaction yields in very large quantities a finely crystallising body,  $\text{C}_{18}\text{H}_7\text{N}_3\text{Br}_{11}\text{O}_7$ , to which the name *bromo-dichromazine* is assigned for the present. It is dichroitic, and does not enter into union with acids. The only compound of a character of a salt results from the action of mercuric acetate, and consists of yellow crystals. Sulphuric acid causes the formation of bromo-dichroic acid,  $\text{C}_{18}\text{H}_7\text{Br}_{11}\text{O}_{11}$ , easily soluble, possessing strong acid properties, and decomposing below  $100^\circ$ . Fusion with  $\text{KOH}$  gives rise to resorcin. By the action of  $\text{HNO}_3$ , as well as of  $\text{Br}$  and water, on bromo-dichromazine, the latter is changed into hexabrom-aceton,  $\text{C}_3\text{Br}_6\text{O}$ . The character of the latter was shown by various reactions. Alkalies give rise to bromoform; nitric acid causes the formation of bromopicrin. In harmony with the formation of dibrom-acetamide from penta-brom-aceton, ammonia changes it into tribrom-acetamide,  $\text{C}_2\text{Br}_3\text{ONH}_2$ , melting at  $120^\circ$ , uniting with neither acids nor bases, and changed by  $\text{H}_2\text{SO}_4$  into tribrom-acetic acid. Hexabrom-aceton forms isopropyl alcohol on treatment with sodium amalgam. The bromo-dichroic acid appears to correspond with the compound mairogallol,  $\text{C}_{18}\text{H}_7\text{Cl}_{11}\text{O}_{11}$ , obtained by Stenhouse from the action of chlorine on gallic acid.

A. LADENBURG, "On Ammonium Compounds." Additional proof is brought to defend the existence of two isomeric triethyl-benzyl-ammonium iodides. "Benzene Formulæ." The author defends his prism-formula against the criticisms of Van't Hoff.

R. NIETZKI, "*Amido-Azo Compounds of the Toluy Series.*" Meta-toluidine yields, with nitrous acid, meta-amido-azotoluen, crystallising in dark blue needles, and forming red solutions when in combustion with acids. Meta-toluidin-hydrochlorate and para-diazo-amido-toluene form metamido-para-azo-toluen, crystallising in yellow leaflets. The author finds that when ortho-toluidin (but not meta or para-toluidin) is brought in contact with para-diamido-toluen and ferric chloride, an intense green colouration ensues.

E. WIDNMANN, "*Nitrobenzoic Acids.*" The melting-points of various mixtures of the isomers are arranged together in a table, and mentioned in connection with the late statement of Liebermann on the subject (CHEMICAL NEWS, vol. xxxv., p. 263).

## NOTICES OF BOOKS.

*The Art of Electro-Metallurgy, including all Known Processes of Electro-Deposition.* By G. GORE, LL.D., F.R.S. London: Longmans, Green, and Co. 1877.

THIS highly interesting and instructive treatise is divided into four very unequal parts, the first of which gives an historical sketch of the subject, and the second the laws and principles upon which the art is based. The longest and most important division of the work treats of the practical part of the art, and this extends over more than two-thirds of the book, while the fourth division—which is intended for the use of practical operators—contains an account of special practical operations of a highly technical character. A list of all the English patents (nearly 300 in number) relating to that subject is given at the end of the work, together with the titles of books on electro-metallurgy.

Starting with the observation of Sulzer made in 1752, to the effect that if lead and silver be placed on opposite sides of the tongue, a peculiar taste is produced when they touch, Mr. Gore passes on to the decomposition of water by static electricity, which was accomplished by Paetz and Van Troostwik in 1790. The real history of the subject commences with Volta's Crown-of-Cups, the first means of producing a current of electricity for any continued length of time. The invention of Cruikshank's battery followed shortly afterwards. Nicholson and Carlisle decomposed water in 1800, and Henry, of Manchester, decomposed nitric and sulphuric acids a few months later. In 1801 Wollaston observed that a piece of silver in connection with the positive end of the battery is coated with copper, if it be placed in a solution of that metal; and in 1805 Brugnatelli gilded two silver medals, by making them the negative pole in a saturated solution of ammoniuret of gold. He also deposited silver upon platinum by a similar process. In 1836 Mr. De la Rue observed that in Daniell's battery the copper plate is covered by a coating of metallic copper, which, on being stripped off, presents an exact counterpart of every inequality of surface of the plate on which it was deposited. Two years later Professor Jacobi, of St. Petersburg, published an account of his galvano-plastic process (*Athenæum*, May 4th, 1839):—"A method of converting any line, however fine, engraved on copper, into a relief by galvanic process, applicable to copper plate engravings, medals, stereotype plates, ornaments, and to make calico-printing blocks, and patterns for paper-hangings." Mr. Spencer, of Liverpool, announced a paper on the *Electro-type Process* on May 8th, 1839; it was read before the Liverpool Polytechnic Society on Sept. 13th of the same year. A detail account of Spencer's paper is given (pp. 7-18). Messrs. Elkington, in conjunction with Mr. O. W. Barratt, patented a process of electrotyping in July, 1838, but the results were not very satisfactory, until Wright proposed the solution of cyanides of gold and

silver in alkaline cyanides, as a liquid for electrotyping purposes. This idea he obtained from a passage in Scheele's "Chemical Essays," in which mention is made of the solubility of the cyanides of gold and silver in an excess of the precipitants. Messrs. Elkington took out another patent in connection with this subject in 1840, but they speedily adopted Wright's process. Two years later Woolwich took out a patent for the use of a magneto-electric machine for electroplating, and although this was employed for several years, it was eventually superseded by newer forms of magneto-electric machines. In 1841 Mr. Smee published a long series of results of experiments on the deposition of various metals. "The chief improvements which have been made in electro-metallurgy since the year 1847 have been the gradual extension of the process for multiplying printing surfaces, in stereotyping, &c.; also the producing of works of art of increased size, in copper, until deposits several tons in weight have been attained; the extensive use of nickel, as a coating upon harness, furniture, &c., the protection of articles of cast-iron, ornamental lamp-posts, &c., from rusting, by a coating of copper; the substitution of magneto-electric machines, and thermo-electric piles, for voltaic batteries; the purification of crude copper in the process of copper smelting; and, quite recently, the economical production of coppered-iron rollers for calico printing, by means of magneto-electric deposition."

The second division of the work treats of the theoretical principles of electro-metallurgy; the elementary facts of electricity, the formation of a current, and the electrical relations of metals.

The next division discusses the practical methods of the art; the general processes of depositing metals, and this is followed by an account of the deposition of individual metals, commencing with hydrogen. Mr. Gore gives his own very interesting experiments on electro-deposited antimony, and on the electrolysis of hydrofluoric acid in some detail, and very many experiments on the electro-deposition of various metals. Detail accounts are given of the processes of gilding and silvering, and the extraction of the precious metals from old solutions.

Gerboin, in 1801, observed that mercury exhibits peculiar movements when it acts as the electrode in electrolysis, and the phenomenon was also investigated by Sir Humphry Davy, Sir John Herschel, and others. Lippmann attributed the effect to a change in the capillary constant. Mr. Gore, while investigating these movements, observed that the surface of the mercury was covered with waves, and that a faint sound was emitted. These *electrolytic sounds* and the motion were found to be due to the alternate formation and destruction of films upon the surface of the mercury.

The method of refining copper by electrolysis is now largely practised, and several hundred tons of the metal are yearly produced by this means. All the impurities are eliminated, and the deposited metal is quite pure. Copper has also been analytically estimated by electrolysis.

In the section which treats of the deposition of the metalloids, Mr. Gore mentions that he has electro-deposited pure carbon from the carbonates of potassium and sodium in a state of fusion; the deposit was black and amorphous, "it burned with a glow, and left a residue." Liquefied carbonic anhydride does not conduct a current from 40 of Smee's elements. According to De la Rue it is not decomposed by the current from 5640 cells of a chloride of silver battery.

The final fifty pages of the work are devoted to special technical processes, and is chiefly designed for those who desire to practise the art of electro-metallurgy. The arrangement of the buildings, depositing vats, and machinery is described in detail, also the various forms of battery. According to Latimer Clark the relative strength of batteries is as follows:—

Grove's .. .. 100	Smee's (when in
Bunsen's .. .. 98	action) .. .. 25
Daniell's .. .. 56	Wollaston's Cop-
Smee's (when not	per and Zinc
in action .. .. 57	in dilute acid.. 46

Mr. Gore is to be congratulated upon the valuable work which he has written; he has spared no pains to make it as complete as possible, and we have no doubt that it will become a standard work in the hands of those who are interested in the subject.

## CORRESPONDENCE.

### THE NEW NICKEL MINERALS FROM NEW CALEDONIA.

*To the Editor of the Chemical News.*

SIR,—In the CHEMICAL NEWS (vol. xxxiv., p. 193) there is a communication from Mr. Typke, in which he comments upon a little paper of mine relating to the new nickel minerals from New Caledonia, read before the Chemical Society of London in 1874.

Mr. Typke states that he submitted the ore to a fresh investigation at the "instigation of Mr. Valentin," and that, as the results which he obtained differed in many respects from those obtained by me, he was induced to make them public.

I am not at all surprised to learn that his sample gave different results, for, as I have already pointed out, the ore varies in composition, and there are at least two fairly well-defined varieties of the mineral.\*

I do not think that Mr. Typke was quite entitled to assume that the mineral which he examined must necessarily be similar to the one which I examined simply because they possessed somewhat similar physical properties, chemical composition, and both came from New Caledonia: they may or may not be the same mineral; probably they are, although it is not improbable that several different nickel minerals may be found in these new Caledonian deposits.

But I would remark that the amount of variation in composition which I have met with during the examination of numerous specimens of the different varieties has not been greater in degree than is often the case in many typical and universally recognised mineral species. I have, however, not yet met with a specimen which gave on analysis such a small proportion of magnesia as that obtained by Mr. Typke. I have found that, unless strong hydrochloric acid be used for the solution of the mineral, there is a risk of leaving some of the magnesia behind in the residue: the majority of the magnesian silicates, it is well known, are but partially or only soluble with difficulty in dilute acids; and in some varieties of the new Caledonian nickel minerals, certainly part of the silicate of magnesia appears to be mechanically mixed with the nickel silicate, even in cases where the mineral to the naked eye appears to be perfectly homogeneous. This is proved by the microscope.

Mr. Typke states that he only employed dilute acid for the solution, and determined the silica by evaporating the whole down to dryness and igniting: it is not mentioned that the silica was tested as to purity—a very necessary thing to do under the circumstances.

Mr. Typke remarks—"Mr. Liversidge ignited his mineral till it ceased to diminish in weight, but does not appear to have observed that after ignition the nickel was no longer soluble, either in hydrochloric acid or aqua regia, whilst before ignition it dissolved freely in dilute hydrochloric acid, leaving insoluble white granular silica behind.

\* For additional analyses see "New Nickel Minerals from New Caledonia," by A. L. *Trans. Roy. Soc. of N. S. Wales.*

The nickel silicate of the mineral, being in the hydrated condition, is converted by strong ignition in a platinum crucible into the *insoluble* anhydrous silicate."

I cannot understand why Mr. Typke should lay so much stress upon the alleged insolubility of the mineral after ignition. I certainly did not observe that the mineral became entirely insoluble after ignition, but I did observe that it was only partly soluble. It is such a common thing for minerals to be less soluble after ignition, and especially in the case of silicates, that it was not considered a characteristic property of these nickel minerals; and, moreover, it is not usual to ignite a mineral strongly before attempting its solution in acid.

Even in cases where the sample of the nickel mineral has been raised to a white-heat for some time, in Fletcher's powerful blast-furnace, a certain part of the nickel present was found to dissolve in hydrochloric, and readily yield a rich green-coloured solution of nickel chloride. The degree of solubility after ignition varies in different varieties of the minerals.

Surely Mr. Typke has not so misread my paper as to be under the impression that I estimated the nickel and other substances in the portion ignited for the estimation of the combined water.

From the unpublished analyses which I have by me the minerals appear to be fairly constant in composition,—i.e., when it is borne in mind that they are evidently the more or less recent decomposition products of other compounds.

The analyses which were published in the *Journal of the Chemical Society* and volume of the Royal Society of New South Wales were made upon the first specimens which came into my hands, and as they had all been repeatedly immersed in water to show their beautiful colour to greater advantage no determinations were made of the water expelled at 100° C.

I must plead my long absence from the Colony as an excuse for the delay in completing my examination of these very interesting minerals, but I hope shortly to have the results ready for publication.—I am, &c.,

ARCHIBALD LIVERSIDGE.

The University of Sydney, New South Wales,  
May 12, 1877.

### DE HAËN'S PROCESS.

*To the Editor of the Chemical News.*

SIR,—In reference to the letter of Mr. F. Versmann, Ph.D. (CHEM. NEWS, vol. xxxv., p. 251) I beg to say I had no thought of depreciating De Haën's process in the communication to which he refers. In saying "there was nothing new in it" I meant that, although not advertised, all its principles had been in vogue for say eight or ten years; for it simply consists of two operations,—first, the separation of lime dissolved by CO<sub>2</sub> by a further addition of lime, and this has been in use in this country as "Clarke's process" for many years, and has been most admirably carried out by Mr. Homersham, C.E., at Caterham and at Tring, where I saw it at work ten years ago.

With regard to the barium, I have been in the habit for many years of prescribing its use for boiler waters largely charged with sulphate of lime.

The "important addition" which I mentioned, and which Dr. Versmann would like to have explained, I cannot just yet very prudently publish, but it had reference to getting rid of the CaCl left in the water, and which, as its density increases by evaporation, causes priming, and is otherwise inconvenient.

In the same number Mr. Andrews refers to Mr. F. G. Rowan's paper on "Boiler Incrustations," &c., which I regret I have not read; but he quotes as follows:—"Prof. Mills informs me that J. Y. Buchanan (of the *Challenger*) was the first who observed that chloride of barium decomposes sulphates and liberates CO<sub>2</sub> from water." Of course

the first part of this quotation is a misconception, because it has been familiarly known to every chemist for twenty years or more that  $\text{BaCl}$  decomposes sulphates; but it is to be regretted that Mr. J. Y. Buchanan gives no explanation why  $\text{BaCl}$  promotes the liberation of free  $\text{CO}_2$  from water whilst boiling, any more than any other fixed salt of difficult solubility, and I should be obliged to any of your correspondents who can explain this remarkable physical property attributed to  $\text{BaCl}$ , so opposite to its chemical affinity.

Five years ago a French chemist, who had been very successful in taking deposits from boiler-water in Vienna, was in this country: he used lime to fix the  $\text{CO}_2$  on Clarke's plan, and soda to deposit lime from the sulphate, and instead of large settling tanks he used compact covered filters, charged with charcoal and wood chips packed tight; but his process cannot be made plain without a diagram, and it must be remembered that when soda is used, sulphate of soda is left in the boiler, which increases much more rapidly than the chloride of calcium which barium leaves in it.—I am, &c.,

ALFRED PAYNE, F.C.S.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 23, June 4, 1877.

**On Vapour Densities.**—M. H. Sainte-Claire Deville.—The author has shown in a former communication that the volumes of oxygen, chlorine, hydrochloric acid, and hydrochlorate of ammonia, whose weights are equivalent to 39 grms. of potassium, are among themselves respectively as the numbers 1, 2, 4, and 8. It is easily shown that simple bodies represent 1 or 2 volumes of vapour; that the binary compounds represent 2 or 4 volumes; and that, lastly, we only find 8 volumes in very complex bodies, in particular in salts with volatile bases and acids. The author has never been able to understand (and many atomists are of the same opinion) why, without strict proof, an attempt has been made to erase from the number of bodies which may exist in the state of vapour those which represent 8 volumes. He gives in the present paper a summary of the arguments against this attempt.

**Researches on the Law of Avogadro.**—M. A. Wurtz.—The author maintains, in opposition to M. Troost, that the vapour of ethyl hydrate is entirely dissociated.

**Atomic Notation.**—M. A. Wurtz.—A reply to M. Berthelot's recent paper.

**Atoms and Equivalents.**—M. Berthelot.—A reply to the above memoir of M. Wurtz in continuation of the controversy which has occupied the last three sittings of the Academy of Sciences. M. Fizeau then expressed the opinion that M. Berthelot had thrown some doubts upon the value of the law of Dulong and Petit, a charge which M. Berthelot repelled. He remarked that between atomic weights deduced from the specific heats of solids, quantities variable with the temperature, whose theoretic signification is obscure, and which are not the same for the different elements, and the atomic weights deduced from gaseous densities, quantities which are constant, and which answer to well-defined physical laws, there is a formal contradiction.

**Parallel Striæ Presented by the Surface of Fragments of Diamond of the "Carbonado" Variety, and on their Imitation by Artificial Friction.**—M. Daubrée.—Natural fragments of carbonado diamond are often found with striated surfaces, which seem to result from the

friction formerly exerted upon them by other specimens of the same mineral. Hence it is probable that the fragments in question, before being scattered and remote from each other as at present, were in contact, so as to exert mutual pressure upon each other.

**Certain Metallic Selenides and Tellurides.**—M. J. Margottet.—A chemical and physical examination of the tellurides and selenides of zinc and cadmium.

**Oxides of Iron.**—M. H. Moisson.—If ferric oxide obtained by calcining oxalate of iron is heated to  $350^\circ$  in a current of pure hydrogen for thirty minutes the result is a black magnetic powder, not pyrophoric, and having the composition of magnetic oxide. It is not a mixture of ferric oxide and metallic iron. If ferric oxide is kept for twenty minutes in a current of pure dry hydrogen at  $500^\circ$  we obtain a black powder duller than the former, magnetic, pyrophoric, and having the composition and properties of ferrous acid. At  $500^\circ$  it decomposes carbonic acid, and becomes transformed into magnetic oxide. If ferric oxide is reduced by hydrogen at  $700^\circ$  we obtain metallic iron which is not pyrophoric. At  $1000^\circ$  the pyrophoric ferrous oxide obtained at  $440^\circ$  loses its properties. There are, therefore, two allotropic ferrous oxides.

**Preparation and Composition of Emetine.**—MM. Lefort and F. Wurtz.—The composition of emetine is  $\text{C}_{28}\text{NH}_{20}\text{O}_5$ . It forms merely basic salts.

**Diffusion of Strontia in Mineral and Organic Matter, both at Present and in Geological Epochs.**—M. L. Dieulafoy.—Strontia exists in sea-water as carbonate and sulphate in 120 species of fossil *Brachyopodes* taken from the entire series of palæozoic formations in all beds of gypsum, and in all mineral waters examined by the author.

**Observations with reference to M. Yvon's Paper on the Nitrates of Bismuth.**—M. A. Ditte.—The author has previously (*Comptes Rendus*, 1874, pp. 956 to 960) obtained most of the results described by M. Yvon.

**Combinations of Quercite with the Butyric and Acetic Acids.**—M. L. Prunier.—Not adapted for abstraction.

**Detection of Salicylic Acid in Wines and Urine.**—M. E. Robinet.—Take 100 c.c. of the suspected fluid, precipitate with acetate of lead in excess, filter, add an excess of sulphuric acid to throw down the lead, and filter again. The perfectly clear liquid is then treated with a few drops of a solution of ferric chloride. If the least trace of salicylic acid is present, say 2 or 3 milligrams per litre, or 1 milligram in case of urine, a beautiful and characteristic violet colour is produced. An excess of sulphuric acid must always be present. To detect if the sulphuric acid employed contains traces of iron it may be diluted with 10 parts of water, and a small quantity of salicylic acid added. If the sulphuric acid contains the smallest trace of salts of iron the violet colour at once appears.

**Observations Relative to M. Bert's Experiments on Carbuncular Disease.**—M. C. Davaine.

**Experiments Proving that in Poisonous Putrid Blood there is no Virus, Liquid or Solid, except Organised Ferments.**—M. V. Feltz.—These two papers are a reply to the experiments of M. Bert, and to the conclusions founded upon them.

*Bulletin de la Société Chimique de Paris,*  
No. 7, April 5, 1877.

**Extraction of Caffeine.**—MM. Legrip and A. Petit.—Already noticed.

**Determination of Piperine in Peppers.**—MM. P. Cazeneuve and O. Caillol.—The ground pepper is treated with twice its weight of slaked lime in a large quantity of water. The whole is heated to a boil for fifteen minutes. The mixture is then dried in a water-bath, and the pipercalcareous powder is placed in the authors' continuous digesto-distillatory apparatus and exhausted with com-

mercial ether. The liquid is partially distilled off, and the residue is abandoned to spontaneous evaporation, when the piperin is obtained in voluminous crystals tinged slightly yellow by a trace of resinous matter. By recrystallisation from boiling alcohol it may be obtained in prismatic crystals of a very pale yellowish tint—its normal colour. White Singapore pepper contains 9.15 of piperine; that of Sumatra ranges from 7.15 to 8.10 per cent, whilst Penang pepper falls as low as 5.24.

**Phosphide of Zinc.**—M. H. Hager.—This compound is prepared by allowing the vapour of phosphorus to act upon melted zinc in a current of hydrogen. Its specific gravity is 4.72, and it contains 25 per cent of phosphorus.

**Preparation of Iodide of Arsenic.**—M. Badcock.—Arsenious acid is dissolved in hydriodic acid, and evaporated to dryness. The compound is thus obtained in yellow crystalline scales, completely soluble in water.

**Hypovanadic Acid and its Compounds.**—J. K. Crow.—Taken from the *Journal of the Chemical Society*.

**Presence of Vanadium in Uranic Oxide.**—Carlington Bolton.—From the *American Chemist* for 1876, p. 363.

**On the Pyrophosphates of Lithium, Lithium and Sodium, and Lithium and Potassium.**—MM. Nahnsen and Cuno.

**Action of Hydrochloric Acid on Chlorate of Potassium.**—M. Schacherl.—These two papers are taken from *Leibig's Annalen*, to the abstracts of which the reader is referred.

A number of papers follow, all taken either from the *Berichte der Deutschen Chemischen Gesellschaft*, from *Leibig's Annalen*, or from the *CHEMICAL NEWS*.

**Determination of Sugar.**—M. R. Sacchse.—The author has tried the method recommended by Knab, (tome xiv., p. 215), founded upon the reduction of mercury cyanide in an alkaline solution by means of glucose. As an indicator to mark the end of the reaction, he makes use of an alkaline solution of stannous oxide, which, in a drop of the solution of mercury cyanide placed upon a white porcelain slab, gives a black spot more or less inclining to brown, according to the proportion of mercury. When all the mercury has been reduced by the sugar, a spot is no longer produced. The indication is very exact, but the results of the method are not constant. The author finds that an alkaline solution of mercuric iodide may advantageously be substituted for the mercuric cyanide. 18 grms. of pure mercury iodide are dissolved in an aqueous solution of 25 grms. of potassium iodide, 80 grms. of caustic potassa are added, and the solution is diluted to 1 litre. To make use of this solution 40 c.c. are placed in a capsule, brought to a boil, and the saccharine liquid introduced by means of a burette. Experiments made with pure glucose show that 40 c.c. of the mercuric liquid (0.72 gm.  $\text{HgI}_2$ ) correspond on an average to 0.1501 gm. glucose. In other words  $2\text{HgI}_2 = \text{C}_6\text{H}_{12}\text{O}_6$ . Inverted sugar reacts upon the mercuric iodide in other proportions than glucose (dextrose) as 40 c.c. correspond to 0.1072 gm. of inverted sugar.

**New Salt of Iron for Steeling Copper Plates for Engravers.**—M. R. Bøettinger.—The author dissolves 10 grms. prussiate of potash and 20 grms. salt of seignette in 200 c.c. of water. He then adds 3 grms. of ferric sulphate in 50 c.c. of water, when a precipitate of Prussian blue is produced. A solution of caustic soda is then added drop by drop till this precipitate is re-dissolved. A clear yellow solution is thus obtained which may be used for depositing iron upon copper. The same liquid may serve for dyeing cloth blue. It is steeped in the liquid, dried in the air, passed into dilute sulphuric acid at 2 per cent, washed and dried.—*Chemisches Centralblatt*.

**Manufacture of Chlorine by Deacon's Process.**—C. Jurisch.—The author examines the causes which interfere with or hinder the production of chlorine in

Deacon's process. Like M. Hasenclever he arrives at the result that the perturbations observed are due to sulphuric acid, but whilst Hasenclever ascribes this influence to a chemical action the author pronounces it chiefly mechanical, the balls of clay becoming coated with an inert layer. He points out that the proportion of hydrochloric acid decomposed depends on three factors:—(1.) The proportions of the mixture of air and hydrochloric acid gas. (2.) The rapidity of the gaseous current. (3.) The temperature of the gaseous mixture and of the balls of clay. The proportion of hydrochloric acid in the gaseous mixture varies from 20 to 60 per cent. Mr. Hurter has found that, other conditions being equal, the relative quantity of hydrochloric acid decomposed diminishes with the proportion of air, and increases with the dilution of the hydrochloric acid. The quantity of hydrochloric acid decomposed is the greater the slower is the gaseous current. The decomposition of hydrochloric acid augments with the rise of temperature.—*Dingler's Polytechnisches Journal*.

**Dyeing with Aloes.**—V. Preston.

**Black Dye for Cloth.**—V. Preston.—These receipts are not of general interest.

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# THE CHEMICAL NEWS.

VOL. XXXVI. No. 920.

## ON REPULSION RESULTING FROM RADIATION.—PART III.\*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 2.)

172. LET me now carry the reasoning a step further. Experiments described in pars. 159 to 168 show that when heat of low refrangibility—from the body (159), the breath (160), hot air, or a warm glass shade (161, 165, 168)—falls on the white and black surfaces, the white is repelled more than the black, rotation of the radiometer taking place in the negative direction. The same rays falling on the two surfaces do more work on the white than on the black; and this, to my mind, appears sufficient to make it almost certain that the white pith absorbs more of these low rays than does the lampblack.

173. Let us imagine that surfaces of lampblack and pith are carried along the spectrum from the blue to the ultra-red. As long as they are in the visible portion we observe an enormous difference between them. In the extreme red we can actually see that this difference is becoming less. In my mind's eye I picture the progress being continued along the whole length of the ultra-red spectrum. I can see, by the light of the above-quoted experiments, that the absorptive action of the two surfaces gradually gets more equal. Soon they become identical in their action on the incident rays, and after that they enter a portion of the spectrum whose rays are no longer absorbed by lampblack, whilst they are quenched by the pith. Lampblack and pith have now changed places; the latter is black, whilst lampblack has become a white substance.

174. The normal rotation of the radiometer caused by dropping ether on it (163) is perfectly well explained by the above hypothesis. If heat in the act of absorption produces motion in one direction, in the act of radiation it produces motion in the opposite direction (167). Heat of low refrangibility falling on the radiometer repels the white more than it does the black, and produces negative rotation. When the same kind of heat is drawn out of the black and white surfaces by the chilling action of the ether, movement takes place in an opposite direction, and the arms rotate normally. On stopping this efflux of heat by covering the instrument with a hot shade (163), I changed the direction of movement by causing the surfaces to absorb instead of emit heat.

An irregular emission or absorption of heat (164) stops the movement altogether, for the reasons given in pars. 155 to 158.

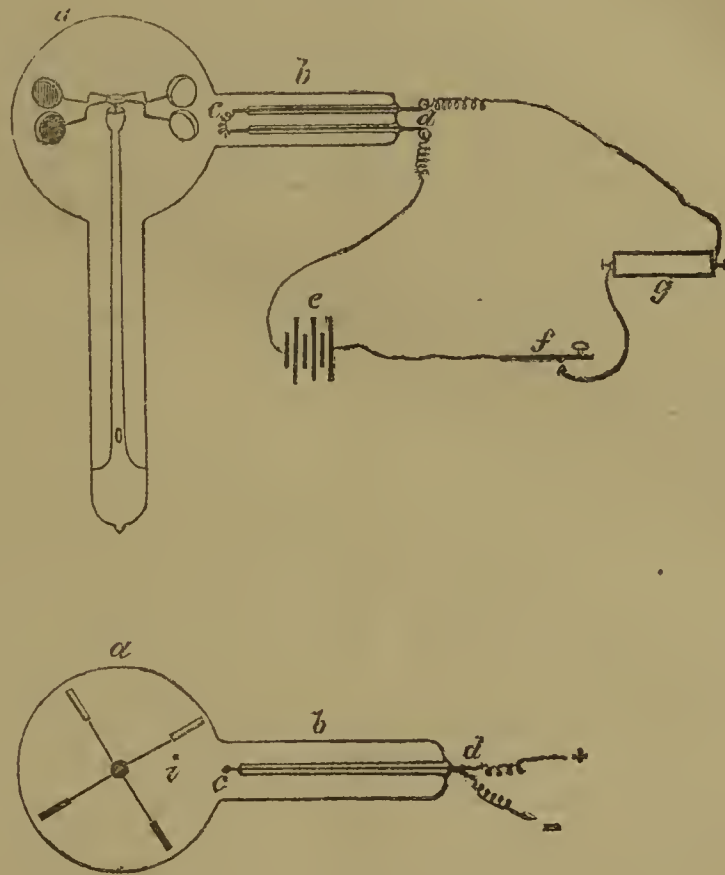
175. I have made an apparatus by means of which I hoped to put the above theory to accurate test. The results are not so definite as they ought to be in order to settle the question; but they are worth giving in detail, as some novel facts have been elicited by them.

Fig. 10 shows the instrument; *a* is the bulb of a radiometer of the usual construction, having pith disks blacked on one side. *b* is a tube sealed into one side of the bulb, and having two stout platinum wires passing along it, sealed their whole length in glass to prevent leakage of air into the interior of the apparatus. At the ends *c* of the wires, a spiral of fine platinum wire is fastened, and the other ends (*d*) terminate in loops outside. *e* is a battery, *f* a contact-key, and *g* a resistance-coil, which I

can vary at will. The bulb was perfectly exhausted, and the following experiments were tried:—

176. The resistance-coil was so adjusted that the battery would keep the platinum spiral (*c*) at a bright red heat. The arms of the radiometer, which were before quite still, moved rapidly until two of the disks were one on each side of the hot spiral, the black disk being further off than the white disk as shown at *i*. The resistance was then gradually increased, and as the temperature of the spiral diminished, the black disk gradually approached the spiral, until, when the temperature was just at the point of visible redness in a dark room, the black and white disks were practically equidistant from the spiral. On diminishing the resistance, the same phenomena took place in inverse order.

FIG. 10.



177. The resistance was adjusted to give a bright red spiral, and the contact-key kept pressed down. The disks stood as at *i*. A lighted match was momentarily brought near the bulb, so as to start a movement. Rotation of the arms commenced, and kept up, with some energy, at the rate of about 1 revolution in five seconds, equal to that given by a candle 8 inches off. There was some little hesitation as the white side came up to the spiral, but this was scarcely noticed when the speed had become steady.

The resistance was slightly increased. The speed became slower as the temperature of the spiral diminished, and the hesitation as the white approached the spiral became more apparent. The resistance was further increased, with the effect of making rotation still slower. I now brought the temperature of the spiral down to just visible redness in the dark. The speed of rotation again slackened; at each approach of the white surface to the spiral it stopped, hesitated, and then got past with a rush. Thus it went on for a few revolutions, until one white disk, a little nearer perhaps than the others, was not able to pass, and the arms after a few oscillations came to rest, the black and white surfaces being, as near as I could judge, equidistant from the hot spiral.

These results fully confirm those obtained in experiments 128 and 144, and I think justify the conclusions arrived at in my discussion of them at par. 171—that at temperatures between 250° and 100° the repellent action of radiant heat is about equal on black and on white surfaces.

178. I now wish to ascertain whether the continuation of the reasoning (172) was correct—whether at temperatures lower than 100° C. the white would be repelled most.

\* A Paper communicated to the Royal Society, January 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

The resistance of the coil was increased again, and the position of the arms in respect to the spiral noticed. When so much resistance was offered to the passage of the current that the spiral would only be just warm, I fancied that the white set further from it than the black; but the observation was not satisfactory at higher temperatures; up to visible redness the repulsion was equal for each.

The breath sent the arms rapidly round the negative way (160).

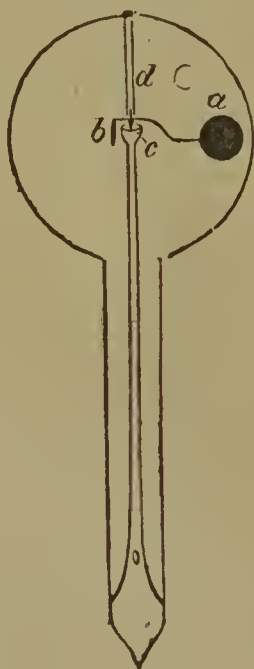
179. The battery was disconnected from the instrument, and one end of a wire was attached to one of the platinum hoops, *d*, the other end of the wire being connected to the prime conductor of a frictional electrical machine. A few turns of the handle sent the arms flying about wildly; sometimes they spun round violently in one direction, then they stopped and went round the other way, finally one pointed steadily to the platinum spiral and refused to move. A candle was brought near, and all means were tried to discharge the disk, but with no effect. When the candle was quite close it overcame the interference, and the disks revolved in an irregular jerky manner.

The spiral was ignited by a battery, in the hope that this would discharge the electricity, but with no avail, and there was nothing to be done but stop the experiments and put the apparatus in water.

In three or four days the electrical disturbance was sufficiently diminished to enable me to proceed experimenting; but I could detect the influence for weeks after.

180. One pole of a small induction-coil capable of giving half-inch sparks in air was fastened to the platinum loops *d*, the other pole being held by an insulating handle. The loose pole was then brought near the bulb. The nearest disk rushed round to it and followed it a little, then it stuck as if the glass were electrified. By gently moving the loose pole round I could get the arms to rotate in either direction with a little practice, and they would keep on for five minutes or more when once started. It seemed a matter of indifference whether the black or the white surface went first. The results with the induction-coil were only a little more under control than those with the friction machine. The movements appear all to be explained by the known laws of static electricity; the rotations have no connexion with the instruments under the influence of radiation, but are of the "electrical fly" kind (34, 35, 36).

FIG. II.



181. Before leaving the subject of the radiometer, it may be of interest if I describe a few forms of this instrument which I have made for special purposes.

It is easy to get rotation in a radiometer without having the surfaces of the disks differently coloured. A radiometer was made similar to the one described in par.

152, but somewhat larger, and having the pith disk lampblack on both sides. Its weight was 1.25 gra in. It was exhausted with a charcoal-tube attached. When it was exhausted and a candle was brought near it, the arms moved until two of the disks were equidistant from the flame, and no amount of initial impulse in one or the other direction would set it in rotation. A piece of ice caused it to move until one disk pointed to the ice, when it also stopped. By shading the candle with a screen, so that the light shone on only one half of the fly, rapid rotation commenced, which was instantly stopped, and changed into as rapid rotation in the opposite direction, by altering the position of the screen to the other side.

182. It is difficult to exhibit the movement of a radiometer to any large number of people at once. To enable me to do this I have made an instrument, the disks of which are thin glass, silvered and polished on one side, and coated with lampblack on the other. This, owing to its great weight (65 grains), is somewhat slow; but in the sun, or with the electric light shining on it, the movement is very striking, as it shows four disks of light chasing each other round the room.

183. A radiometer was made of the following construction (fig. 11). *a* is the disk of pith, black on one side; it is attached to a thin brass arm revolving on a needle-point; *b* is a mirror, seen in section, hanging from the other side of the brass arm, and having its plane perpendicular to the plane of the pith disk *a*. The needle-point works in a jewel cup *c*, and is prolonged upwards into the tube *d*, which is sealed into the bulb, and in which the needle fits loosely. Behind the mirror *b* is a very small magnet, to give direction to the arm. The object of having the upper tube (*d*) is to prevent the arm from coming off in carriage: with the four, or more, armed radiometers it is easy to get the movable part on when it falls off, but with this one-armed instrument it would be an almost impossible feat. (This artifice of an upper protecting tube is one I have had occasion to adopt on many occasions, and I find it very convenient). The moving part weighs 2.42 grains; it revolves somewhat slowly when a candle is brought near, owing to the interference of the magnet. When the magnet is rendered nearly astatic by another magnet near it, and an index ray of light is reflected from the mirror, this radiometer is sensitive to a candle several yards off. It is a more convenient instrument for measuring different kinds of radiation than is the one on a similar principle described in par. 135, but, owing to the friction on the needle-point, it is not so sensitive.

184. A large radiometer in a 4-inch bulb was made with ten arms, eight of them being of brass, and the other two being a long watch-spring magnet. The disks are of pith, blackened on one side. The weight of the fly is 11.87 grains. This moves very rapidly for so heavy an instrument. The power of the earth on the magnet is too great to allow the arms to be set in rotation, unless a candle is brought very near; but once started it will continue to revolve with the light some distance off. This was made to enable me to communicate motion from the interior of the bulb to the outside. By suspending a magnet near the bulb, it oscillates to and fro with every revolution of the radiometer. The movement can thus either be projected on a screen or it may work a telegraphic instrument, and thus give a visible demonstration or a permanent record of the revolutions caused by any source of light under examination. As a self-registering photometric instrument this form of radiometer would be of considerable value.

185. A large six-disk radiometer was made in a 4-inch bulb. Immediately over the needle support a silvered glass mirror was fixed almost, but not quite, horizontal. By throwing a beam of light vertically downwards on this mirror it is reflected upwards at a slight angle, and as the radiometer revolves the movement can be seen by an audience as a spot of light traversing in a circle around the ceiling. The effect of various lights, coloured screens,

&c., in modifying the rapidity of movement can be well illustrated in this manner.

In a subsequent paper, which I hope soon to have the honour of laying before the Society, I propose to give the results of my experiments on the different rays of the solar spectrum, on the action of light and heat on various surfaces other than black and white, and on some attempts I have made to measure the force of radiation.

To be continued.)

## ANALYSIS OF BOILER INCRUSTATIONS.

By EDWARD FRANCIS.

A BOILER manufacturer of this town lately placed in my hands for analysis three apparently very dissimilar boiler deposits.

1. A brown cake, half-an-inch thick, from a small egg-end boiler, using water drawn from the south-west face of the Anticline of Brimington in the middle coal measures. The incrustation was hard, only partially soluble in HCl (the solution being red), and nearly completely soluble in Aqua Regia.

The complete analysis shows—

Calcium sulphate	.. .. .	75.65
Silica	.. .. .	5.64
Ferric oxide	.. .. .	4.71
Magnesian oxide	.. .. .	4.85
Loss on ignition (water and organic matter)		8.61
Phosphoric acid	.. .. .	trace
Sodium and potassium	.. .. .	trace
		99.46

2. A very light grey cake, about three-eighths of an inch thick, readily pulverised, a portion taken up by water. This was obtained from a boiler fed by water from the Sheffield Water Company's Mains. The aqueous solution contained CaMg and H<sub>2</sub>SO<sub>4</sub>. It was not entirely soluble in HCl, the solution being of a pale yellow colour. The subjoined analysis leads to the inference that the water used was permanently hard, and that it had little action upon the iron of the boiler.

Calcium sulphate	.. .. .	79.56
Calcium carbonate	.. .. .	5.05
Ferric oxide	.. .. .	1.53
Aluminic oxide	.. .. .	1.02
Magnesian oxide	.. .. .	5.34
Water and organic matter	.. .. .	7.75
Sodium and potassium	.. .. .	trace
Phosphoric acid	.. .. .	absent

100.25

3. An extremely hard residue, three-eighths of an inch thick, taken from a tubular boiler at Heeley, near Sheffield, the water used being pumped from a well. It was very difficult to powder, but was entirely soluble in aqua regia. The cake in places showed minute specks of metallic iron; these were afterwards dissolved out by iodine solution. A large percentage of ferric oxide exist in this incrustation. The following is the complete analysis—

Calcium sulphate	.. .. .	37.06
Ferric oxide	.. .. .	38.98
Aluminic oxide	.. .. .	1.62
Organic matter and water	.. .. .	8.80
Magnesian oxide	.. .. .	10.36
Carbonic acid	.. .. .	2.58
Metallic iron	.. .. .	trace
Sodium and potassium	.. .. .	trace

99.40

St. Helen's Terrace Chesterfield.

## RESEARCHES ON PSEUDO-PURPURIN:

A SEQUEL TO

## RESEARCHES ON THE COLOURING-MATTERS OF Madder.

By M. A. ROSENSTIEHL.

I HAVE already shown that pseudo-purpurin heated to 180° evolves carbonic acid, and leaves a residue consisting of purpurin. This decomposition would lead to the formula C<sub>15</sub>H<sub>8</sub>O<sub>7</sub>. The figures given by analysis do not agree exactly with those indicated by calculation, and I have put forward the opinion that the difference may be due to the presence of purpurin in the product analysed.

The object of the present paper is to confirm this latter point, to give the percentage composition of purified pseudo-purpurin, and to describe some of its properties.

1. If we treat pseudo-purpurin with a hot liquid capable of dissolving purpurin alone, we are never certain whether the latter had pre-existed in the product, or whether it was the result of a decomposition. The use of solvents being thus interdicted, I have made use of tinctorial trials to solve the question. I have shown, in fact, that pseudo-purpurin does not dye with mordants save in presence of distilled water, and that it is totally precipitated from the dye-beck by its equivalent of carbonate of lime, whilst under the same circumstances purpurin produces its maximum results in dyeing. Proceeding upon this basis it became easy to show that pseudo-purpurin, prepared according to the instructions of Schützenberger and Schiffert, still retains purpurin.

2. To render pseudo-purpurin more accessible to solvents I transformed it into a soda-salt by means of the carbonate. On treating the aqueous solution of this salt with an acid I obtained a finely-divided precipitate, which was stirred up in cold alcohol. The first portions were coloured brown, the subsequent ones red; the former contained purpurin, but the latter pseudo-purpurin, as I have proved by tinctorial experiments. For 100 grms. of matter I used about 20 litres of alcohol.

The analysis of the product dried *in vacuo* at 100° gave—

	Experiment		Calculation (C <sub>15</sub> H <sub>8</sub> O <sub>7</sub> ).	Analysis by Schützenberger and Schiffert.
	I.	II.		
C .. ..	60.36	60.15	60.00	61.00
H .. ..	2.68	2.80	2.66	3.00

These results, if we consider the difficulty attending the purification of such bodies, are sufficient to establish the formula C<sub>15</sub>H<sub>8</sub>O<sub>7</sub>, which agrees perfectly with the decomposition which I have observed.

To satisfy myself that the latter is well-defined, and answers to the equation—



I executed a combustion divided into two stages: in the former the portion of the tube containing the compound was only heated to 180°, whilst a slow current of pure air traversed the apparatus; the result was 14.9 of carbonic acid in place of 14.6 required by calculation. The combustion of the fixed residue gave—

	Experiment.	Calculation (C <sub>14</sub> H <sub>8</sub> O <sub>5</sub> ).
C .. ..	65.32	65.62
H .. ..	3.16	3.12

The experiment agrees perfectly with the formula—



which I have assumed as definitely established. It contains the following groupings:



Pseudo-purpurin, therefore, is an acid comparable to the salicylic, which also by the action of heat is resolved into

carbonic acid and phenol. Nevertheless I have not succeeded in producing it, as has been done with the latter, by the action of carbonic acid upon the alkaline derivative of purpurin. I am continuing this investigation synthetically.

3. I have obtained pseudo-purpurin, crystallised in large brilliant laminæ, on exposing to the air the solution of its soda-salt in a mixture of water and alcohol.

4. On treating it, either dissolved in alkalies or in concentrated sulphuric acid, with reducing agents, there is formed an unstable addition-product which dyes with aluminous mordants and yellow-orange shade. On exposure to the air it gradually reverts to the state of pseudo-purpurin; in an alkaline solution this change is more rapid. This product, which I was unable to analyse on account of its instability, appears interesting because it possibly represents the state in which pseudo-purpurin exists combined with a saccharine body in madder. We know, indeed that the plant contains the tinctorial matters in a soluble, but slightly coloured, condition. It is only on prolonged exposure to air, during which a process analogous to fermentation is set up, that the tinctorial properties are developed.

5. It is important to observe that the remarkable instability of pseudo-purpurin is a fortunate circumstance, since neither it nor alizarin would have given to any plant the importance of madder.

The former of these compounds is too fugitive a tinctorial substance, and the reds yielded by the latter are deficient in brightness. The production of purpurin in industrial procedures corrects at once these two defects: the pseudo-purpurin is replaced by a compound yielding fast colours, the tone of which mingling with that of alizarin gives it that brilliance on which its commercial value depends.—*Comptes Rendus*.

## ON IRON AS A NATURAL CONSTITUENT OF WINES.

By C. R. ALDER WRIGHT, D.Sc. (Lond.),  
Lecturer on Chemistry in St. Mary's Hospital Medical School.

THAT iron sometimes exists in the ash left on evaporating wines to dryness and incinerating the residue has long been known; but in many cases it is not so certain as to how far this iron was pre-contained in the grape-juice employed, and how far it was derived from substances added to the wine during the process of manufacture—notably from gypsum used in the "plastering" process adopted in some cases, or from impurities in the glucose, &c., added to the grape-juice so as to obtain a larger alcoholic yield. The wine employed in the following experiments was obtained direct from Messrs. Auld, Burton, and Co., of the Auldana Vineyards, South Australia, and 8, Mill Street, Hanover Square, W. It had been grown and made under the superintendence of one member of the firm in Australia, imported in cask, and bottled in the London stores of the firm, so that, not having passed through the hands of agents, its genuineness and freedom from sophistication were as well guaranteed as such matters can be.

The following numbers represent the analytical figures obtained with two varieties of Auldana wine, distinguished as "Ruby" and "White." The alcoholic strengths are necessarily only close approximations, as each wine was heavily charged with volatile compound ethers, imparting a marked and peculiar bouquet, and communicating to the wines a higher exhilarating effect than that simply due to the actual alcohol present. It is noteworthy that the sulphates present are very low, and in less quantity than the potassium bitartrate, which indicates that no plastering had been adopted in either case, whilst the low percentage of grape-sugar shows that the fermentative process had been carried out very completely.

The numbers represent the grammes of each constituent per 100 c.c. (or grains per 100 fluid grains).

	Ruby.	White
Sp. gr. at 60° F. . . . .	0.9874	0.9884
Alcohol and volatile compound ethers	10.500	12.000
Grape-sugar . . . . .	0.207	0.248
Anhydrous sulphuric acid (SO <sub>3</sub> ) . . . . .	0.043	0.048
Do. phosphoric acid (P <sub>2</sub> O <sub>5</sub> ) . . . . .	0.020	0.023
Chlorine (Cl) . . . . .	0.015	0.015
Silica (SiO <sub>2</sub> ) . . . . .	0.007	0.008
Potassium bitartrate* . . . . .	0.123	0.136
Potash (K <sub>2</sub> O) in other conditions than as bitartrate . . . . .	0.127	0.106
Soda (Na <sub>2</sub> O) . . . . .	0.026	0.023
Ammonia (NH <sub>3</sub> ) . . . . .	0.007	0.010
Lime (CaO) . . . . .	0.016	0.014
Alumina . . . . .	traces	traces
Magnesia (MgO) . . . . .	0.025	0.027
Protoxide of Iron (FeO) . . . . .	0.001	0.001
Volatile acids (calculated as acetic acid) . . . . .	0.214	0.108
Glycerin, dextrin, tannin, vegetable acids, &c. . . . .	2.375	2.657
Water (by difference) . . . . .	86.294	84.576
	100.000	100.000
Total solid constituents . . . . .	2.992	3.316
Total free acid (calculated as tartaric acid) . . . . .	0.704	0.652
Total potash present (K <sub>2</sub> O) . . . . .	0.158	0.140
Matters left on in incineration :—		
Alkaline portion calculated as K <sub>2</sub> CO <sub>3</sub> . . . . .	0.131	0.089
Neutral substances soluble in water . . . . .	0.150	0.143
Matters insoluble in water . . . . .	0.060	0.076
Total . . . . .	0.341	0.308

\* Containing of K<sub>2</sub>O: Ruby, 0.031; White, 0.034.

The determination of the state in which the iron present existed being of some interest, the following experiments were made, a large bulk of wine being employed (upwards of 10 litres of each kind) :—

*Determination of total Iron present.*—Known bulks were evaporated to a syrup and charred; the matters soluble in water were dissolved out and the residue burnt white; finally, the total iron in the aqueous solution and ashes jointly was determined; amongst other processes, colorimetric tests—by comparison in Nesslerising cylinders with a weak standard iron solution, by means of ferrocyanide of potassium—were employed, and with fairly satisfactory results. The numbers deduced from several accordant observations gave the following average amounts, the iron being calculated as FeO :—

Ruby.	White.
0.00130	0.00130

each wine containing sensibly the same amount of iron.

That the iron was not present as a salt of the peroxide was evident from the circumstance that each wine contained œnotannin, striking a bottle-green tint with ferric salts; moreover no ferric reaction could be obtained with ferro- and sulpho-cyanides. On the other hand, ferricyanides gave on standing a blue precipitate in each case, showing the presence of soluble ferrous salts. In order to see if iron in other forms of combination (*e.g.*, analogous to blood-hæmatin) was present, known large bulks of wine were precipitated by acetate of lead, whereby almost complete decolorisation ensued; the precipitates were well washed, dried, and incinerated, the lead separated from the nitro-hydrochloric solution of the ashes by pure sulphuric acid, and the iron in the filtrate deter-

mined colorimetrically. In this way the following numbers were obtained:—

	Ruby.	White.
Iron in lead precipitate (calculated as FeO) .. .. .	0.00060	0.00020

Hence it would seem that in the case of the ruby wine nearly one-half of the total iron present was carried down in the lead precipitate, whilst in the white wine only about one-sixth was thus precipitated. The experiments described below, however, indicate that the iron thus precipitated must have been carried down by a kind of mordanting action with the colouring-matter, more being of course thrown down with the most coloured wine, and not that the iron was really an integral part of the colouring-matter itself.

To see if any colloid iron compound was present, the wines were dialysed through clean bladders immersed in about 5 parts of distilled water for 1 part of wine. Every day or two days the water was changed. For the first two or three changes much iron was contained in the diffusate, but it soon began to diminish, and after five changes the diffusate only contained very small quantities of iron. The residual fluids in the bladder were then evaporated to dryness, and the residues incinerated and the iron determined. In this way there was found—

	Ruby.	White.
Iron remaining in bladders after ten days' dialysis (calculated as FeO) .. .. .	0.00018	0.00016
Iron originally present .. .. .	0.00130	0.00130

So that 86 per cent of the iron had dialysed away in the case of the ruby, and 88 per cent with the white wine. The small residual amount doubtless was due to the dialysis not being carried to the absolute limit.

A clear proof that the iron contained was practically wholly present as a salt of the protoxide was furnished by determining the amount of iron contained in the blue precipitate thrown down by ferricyanide of potassium, on standing and after washing. The quantities thus obtained (after deducting the iron in the precipitate due to the ferri-cyanogen) were—

	Ruby.	White.
Iron precipitated by ferri-cyanide (calculated as FeO) .. .. .	0.00146	0.00146

The excess thus found over the total iron previously obtained (0.00130 in each case) is doubtless due to loss of a little iron during the incineration process, and other experimental errors.

On examining the analytical figures given above it is manifest that the potash and soda of the wines are in greater quantity than would suffice to neutralise the sulphuric and phosphoric acids and the chlorine, so that the ferrous oxide present can hardly have been contained as an inorganic salt; nor could it have been present as a tartrate, since presumably the tartaric acid would be wholly contained in the form of potassium bitartrate, much more potash being present than corresponds to the cream of tartar obtainable from the wine by precipitation with alcohol and ether, and the wine being of acid reaction. Hence the iron must have been present as a ferrous organic salt, probably malate or acetate.

Two circumstances are noteworthy as connected with the presence of iron in what there is every reason to believe were samples of wholly unsophisticated wine: first, that contact of the grape-juice with ironwork of any kind is studiously avoided, the crushing of the grapes being effected by means of wooden rollers covered with felt, and the fermenting-vats, &c., being constructed of slate; secondly, that the soil of the Auldana vineyard is exceptionally ferruginous, the general petrological character of the district being decomposed clay-slate and limestone, with frequent deposits of ironstone. That iron is taken up from the soil by trees and vegetation generally, in mi-

nute quantity, is rendered certain from the constant occurrence of traces at least of that metal in the ashes of plants and vegetables of nearly all kinds; so that there is no inherent improbability, but rather the reverse, in the notion that the highly ferruginous soil of the Auldana vineyard, together possibly with climatic peculiarities, is the cause of the occurrence of iron in the finished wine. On the other hand, the circumstance that almost identical values were obtained with each kind of wine (the white being of 1872 vintage and the ruby of 1873) renders it improbable that the source of the iron is outside of the grape-juice; for the grapes used for each kind of wine are the same, the differences being that in the production of the ruby wines the skins are fermented with the juice, whilst in the manufacture of the white wine they are previously carefully removed, and that the maturation and refining are carried out under slightly different conditions as to temperature, &c.

It deserves notice that the Auldana wines, being thus apparently ferruginous from purely natural causes, and containing considerable amounts of phosphoric acid, are to some extent analogous to "lactophosphate of iron," "Parrish's Chemical Food," and the like; not improbably, therefore, they will be found valuable from a medicinal point of view as highly agreeable tonics.

## REPORT

### ON THE METHODS EMPLOYED IN THE ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS, AND ON THE MODE OF STATING THE RESULTS.\*

(Continued from p. 270.)

FROM these experiments it appears that the employment of the processes of Fresenius and Frank, leads to results sensibly above the truth if a large excess of platinum be employed. The fact that in *all* the experiments the error is in the same direction, indicates that it is not due to defective manipulation. When only a slight excess of platinum is employed in the above methods, the results are decidedly better, but present greater differences among themselves, as if some other disturbing cause came into operation. This is notably the case with Frank's method, the error in only six experiments varying from 0.01 per cent to 1.07.

The results by Tatlock's method distinctly indicate a tendency to loss, but this is chiefly noticeable in the cases in which the proportion of sodium chloride was very high (50 per cent). In fact, four experiments with a mixture similar to that which usually occurs in practice (*i.e.*, 82 per cent KCl and 18 NaCl) gave results showing an error in *excess* of the truth varying from 0.09 to 0.20 per cent. The thirteen determinations by Tatlock's method show a maximum error of 0.40 per cent. In this experiment the quantity of material employed was *measured* in the pipette, and for several reasons this plan was found less trustworthy than the *weighing* of the solution used. With the view of ascertaining the cause of the loss observed in some cases by Tatlock's method in presence of a large proportion of sodium chloride, an experiment was made by treating a mixture of 30 milligrams of KCl and 0.7 gram of pure NaCl with 30 c.c. of the platinum solution (the usual quantity) and estimating the potassium in the usual way. By employing a small quantity of KCl it was thought that other errors of manipulation would be avoided, and that the experiment would be practically to ascertain the ex-

\* Report of a Committee of Section B., British Association, consisting of E. C. C. Stanford, James Dewar, Alfred E. Fletcher, E. W. Parnell, T. R. Ogilvie, and Alfred H. Allen (Secretary). Drawn up by Alfred H. Allen.

tent to which chloroplatinate of potassium was soluble in a solution of platinic chloride containing much chloride of sodium (or, in other words, in a solution of sodium chloroplatinate). The weight of potassium chloroplatinate which should have been yielded by the above quantity of KCl is 0.0982 grm., whereas the weight actually obtained was only 0.0915 grm. Hence there was a loss of 0.0067 grm. In another experiment in which only 0.35 grm. of NaCl was used, the quantities of KCl and platinum solution remaining as before, a loss of 0.0042 grm. of chloroplatinate was observed. In this last experiment the potassium chloride corresponding to the chloroplatinate obtained was only 95.7 per cent of the quantity added, while in the previous experiment it amounted to 93.2 per cent. From these results, and those recorded in the tables, it appears that the percentage error is larger the greater the proportion of sodium salts present, a fact which appears to point to the solubility of the precipitate in solution of sodium chloroplatinate as the origin of the loss. Thus, in the experiments in which pure chloride of potassium was employed, and in those in which the amount of sodium chloride was small, the variation from the truth was exceedingly slight, but the error became greater with the amount of sodium chloride present. In experiments 42 to 50 the amount of chloride of sodium and platinum solution employed were the same as in the test experiment in which a deficiency of 0.0042 grm. of precipitate was observed. If we assume that this loss is the weight of  $K_2PtCl_6$  dissolved by the use of 0.35 grm. of NaCl and 30 c.c. of platinum solution, then a correction of 0.0042 grm. ought to be applied to each of the results of experiments 42 to 50. This correction of 0.0042 grm. in the weight of the precipitate corresponds to 0.37 per cent of KCl. The mean of the nine experiments above referred to is 99.58 per cent of KCl, which, with the correction 0.37, amounts to 99.95 per cent. From these considerations it appears almost certain that the deficiency is due to the solubility of the precipitate in platinum solution containing sodium chloroplatinate.

If a loss of about 4 milligrams. produces an error of 0.37 by Tatlock's method, the discrepancy would be much greater by Frank's, in which a smaller weight of the sample is employed. This fact, and the very strong alcohol required, render this process less satisfactory than that of Fresenius. Why the latter process should give results in excess of the truth, even when the modified method (II.) was used, seemed difficult to explain. With a view of ascertaining the cause, three quantities of pure chloride of potassium with equal weights of chloride of sodium, were treated by Method I. After weighing, the precipitates were dissolved in hot water, 10 or 12 drops of platinum solution added, and the process of evaporation, &c., repeated. The following results were obtained:—

TABLE VI.

Experiment	Weight of Solution.	KCl taken.	1st precipitation.			After re-dissolving.		
			Weight of Precipitate.	= KCl found.	= KCl per cent.	Weight of Precipitate.	= KCl.	= KCl per cent.
61	3.8530	0.35027	1.1542	0.35272	100.70	1.1527	0.35226	100.57
62	3.8725	0.35204	1.1606	0.35469	100.75	1.1615	0.35495	100.82
63	3.8770	0.35245	1.1618	0.35504	100.73	1.1609	0.35478	100.66

In these and in all previous experiments the precipitates were dried at 100° C.

In the last edition of his "Quantitative Analysis," Fresenius directs the precipitate to be dried at 130° C. To ascertain if this difference of treatment was the cause of the error, some pure potassium chloroplatinate was prepared by rapidly cooling a saturated solution of the salt in boiling water. In this way it was obtained as a fine crystalline powder. By the slow evaporation of the mother-liquor another sample was obtained in the form of "scales." The products were dried for half-an-hour at 100° C, and

3 grms. of each exposed to a higher temperature with the following results:—

TABLE VII.

	Crystals.		Scales.	
	Loss on 3 grms.	Loss per cent.	Loss on 3 grms.	Loss per cent.
After 1 hour additional at 100° C... ..	none	none	none	none
After ½ hour additional at 130° C... ..	0.0005	0.017	0.0015	0.005
After 1 hour additional at 140° C... ..	0.0015	0.050	0.0005	0.017
After ½ hour additional at 200° C... ..	0.0080	0.270	0.0075	0.250

It will be seen that no loss occurred on further drying at 100° C., and a very trifling loss at 130°. After heating to 140° there was a slight change of colour. At 200° decrepitation and incipient decomposition ensued. The total loss at a temperature not exceeding 140° was only 0.067 per cent of the weight of the precipitate. This, in the experiments by Method I., would only cause a difference of 0.02 per cent on the quantity of chloride of potassium found. Hence it is clear that there is no advantage in drying the precipitate at 130° rather than at 100°. On the other hand the occurrence of decrepitation shows that the crystals contain cavities filled with water or platinum chloride solution, and therefore that the production of large crystals should be avoided. It seems possible that the difference in the nature of the liquid filling the cavities may be the cause of the greater error observed when a large excess of platinum solution is employed than when little more than the theoretical amount is used.

In the foregoing tables the results obtained by Frank's method were calculated with the Committee's factor 0.3056, instead of that employed by Frank and Berrand themselves (0.30507).<sup>\*</sup> By the use of the latter factor the results would come out about 0.17 per cent lower than the figures given in the tables. Some of the results by this process are exceedingly good, but in other cases they are seriously in excess of the truth. (See Experiments 3, 4, 59 and 60.)

(To be continued.)

## NOTES ON SPECIMENS OF CHRYSOCOLLA.

By W. M. HUTCHINGS.

ON a former occasion (CHEMICAL NEWS, vol. xxxiv., p. 141) I communicated two analyses of chrysocola and "kupferpecherz," made on specimens of the ore known in this country as "Mexican ore," which is mined, I am informed, in Lower California. Since then, having obtained many more very interesting specimens, I have made further analyses, some of which are, perhaps, of sufficient interest for publication.

Many pieces of the ore are found which consist of two very distinct varieties of chrysocola, one part being hard, vitreous, and of a fine bluish green colour (exactly like the specimen formerly analysed), while another portion is soft and earthy, of a pale bluish white colour, so pale that it is often almost quite white, and is so light and porous that it will float for some time upon water—till it has absorbed sufficient to cause it to sink. This earthy variety is so soft that it can be cut easily with a knife, and can be scratched with the finger-nail. One specimen

<sup>\*</sup> The factor employed by Frank and Berrand is based on Andrews's determination of the atomic weight of platinum. This observer states that potassium chloroplatinate retains 0.55 per cent of water even when dried at temperatures considerably above 100° C. If this be true the low factor employed by Frank and Berrand would partly compensate the error thus introduced. In the experiments detailed in the test, only 0.27 per cent was lost at a temperature of 200°, but further decrepitation occurred on raising the temperature still higher.

was found to absorb 85.5 per cent of its own weight of water, after which it had almost as deep a colour as the vitreous variety.

Dana mentions the occurrence of similar specimens, and gives an analysis by Scheerer, saying, "The chrysocolla analysed by Scheerer occurs with felspar, and is supposed to have resulted from the action of sulphate of copper on the felspar. Some specimens of the chrysocolla are transparent and brittle on one part, and earthy, like decomposed felspar on the opposite." It is not stated on which portion of the specimen Scheerer made the analysis.

I have never found any felspar among this ore, and do not know whether they occur together at the mines. (So far as I am aware no description of these wonderful deposits has yet appeared anywhere; a mineralogical and geological report on them would be of the highest possible interest.) Many of the earthy specimens do certainly, in some respects, much resemble decomposed felspar in appearance.

I selected a large piece, weighing several pounds, of which about one half was vitreous, and the other half earthy, and after breaking off the outer portions, took samples of both varieties for analysis, the results being as follows:—

The finely-powdered minerals were dried at 95° C. for some hours.

	Vitreous.	Earthy.
Total silica .. ..	67.07	46.45
Copper oxide .. ..	24.95	39.15
Lead oxide .. ..	0.26	0.41
Ferric oxide .. ..	0.27	0.48
Alumina .. ..	0.55	3.65
Zinc oxide .. ..	0.09	0.10
Lime .. ..	0.81	0.80
Magnesia .. ..	0.37	0.82
Water .. ..	5.82	7.99
	100.19	99.85

The specimens contain also traces of cobalt and manganese and small amounts of  $P_2O_5$ .

The difference in composition is sufficiently striking. The presence of alumina in both varieties, and its much larger amount in the earthy one is very noteworthy, as no alumina is found in specimens from large pieces on which none of the earthy chrysocolla occurs.

The mineral of these deposits is doubtless "true chrysocolla" (if, indeed, any definite composition can be singled out as representing a normal chrysocolla), mixed with large amounts of opal silica, the proportion of this latter varying very much, but remaining pretty constant in specimens which are alike as to colour, hardness, &c. The proportions of the chief constituents of the vitreous mineral, as above, do not differ very much from those of my former analysis.

There is also a certain amount of silica very finely disseminated through the mineral as quartz and chalcedony. It would be interesting to know the proportion of this; and in specimens which contain no alumina, and but little lime and magnesia, the determination can be made with some approach to accuracy, as the silica separated by long digestion with strong HCl is almost perfectly pure, dissolving easily in moderately-concentrated solution of  $Na_2CO_3$ , leaving a residue consisting almost entirely of sharp, gritty, transparent or white grains. But when alumina is contained, pure silica is not obtained by HCl, and a similar determination of the quartz silica is not practicable. In the above analyses I can only roughly estimate it to be about 3 per cent in the vitreous, and less than 1 per cent in the earthy variety.

The earthy chrysocolla is more or less fusible, apparently owing to the increase in alumina. Its composition seems to vary somewhat, even in small homogeneous-looking specimens, as bits chipped off one portion are easily fused to a ball before the blowpipe, while bit from another

portion can only be sintered and rounded on the edges. The above analysis was made upon a sample of about 20 grms., chipped from various places on the one large specimen. The powder is not quite fusible; made into a little flat "cake" of paste with water, it can just be fused at the edges, the rest sintering together.

The vitreous mineral is not in the least degree fusible. It turns black at first, but on continued exposure to a strong oxidising flame it becomes red, probably from the formation of some cupreous silicate. The fusible mineral does the same at first, but when fusion or sintering has taken place the colour is dirty yellow.

Laboratory, Wallasey Ore Works,  
Birkenhead, June 15, 1877.

In addition to the minerals of which I have already given analyses occurring in the chrysocolla-ore from Lower California, I have found a small quantity of what appears to be another variety of the "kupferpecherz." It has hardness of 2 to 3, black streak, and is very easily fusible before the blowpipe; differing in these respects from the variety formerly analysed (CHEMICAL NEWS, vol. xxxiv., p. 141). I have found it only in thin layers, alternating with chrysocolla and fibrous gypsum. Its composition is as follows, the powder being dried previous to analysis at 95° C.:—

	Per cent.
Silica .. ..	11.95
Copper oxide .. ..	14.20
Ferric oxide .. ..	9.35
Zinc oxide .. ..	0.80
Cobalt oxide .. ..	0.95
Manganous oxide .. ..	38.53
Oxygen .. ..	7.89
Lime .. ..	2.41
Magnesia .. ..	2.35
Sulphuric anhydride .. ..	0.16
Water .. ..	11.61
	100.20

June 25, 1877.

## ON THE PRESENCE OF OCCLUDED OXYGEN IN STEELS, ESPECIALLY IN BESSEMER STEEL.

By SERGIUS KERN, St. Petersburg.

ENGINEERS making cast steel by the Bessemer process know very well the following two facts:—

1. That on adding to the metallic bath in the converter melted spiegeleisen a very high flame rises from the mouth of the apparatus, which is, first, of a very white colour, and next gradually changes, the flame becoming crimson when all the spiegeleisen has been poured in and the retort is turned to the casting ladle. It must be mentioned that during all this time there is no blowing through the apparatus, so that no abundant quantity of oxygen can be supposed to be present in the apparatus, however the flame mentioned above is of a very oxidising character.

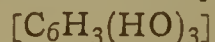
2. As the metal in the apparatus is thoroughly decarburised, which may be easily ascertained by the spectroscope, and as the percentage of carbon in the spiegeleisen coming from the cupola may be strictly determined, it is evident that the percentage of carbon in the obtained steel may be very easily and exactly predicated. However, in the resulting steel a lower percentage of carbon is always found than ought to be, according to the calculations of the metallurgist; but a higher percentage in this case was never determined—certainly in this case the process must be very accurately executed.

This is still an open question in metallurgy. Leaving to the metallurgists the study of these interesting facts, I merely mention here that some chemists explain this metallurgical point by the occlusion of oxygen in melted steel, and some of them tell us that even solid steel contains oxygen in very minute quantities.

At the moment when the spiegeleisen is added to the metallic bath, a certain quantity of the carbon which it contains combines with the occluded oxygen, forming carbonic oxide (CO), which flies away, giving to the hot gases coming out from the retort a crimson tint; indeed, carbonic oxide burnt in sufficient quantity, imparts to the flame a crimson tint. In such a case, when a certain quantity of carbon is burnt, the resulting steel must contain less carbon than was expected.

In order to ascertain the presence of oxygen combined with the steel in the metallic bath of the Bessemer apparatus before the addition of spiegeleisen several experiments were made. As no special method for the determination of oxygen in steels could be found in manuals of analytical chemistry, a very easy method was devised which, noticed here, may be of some use to chemists for further experiments:—

100 grms. of the steel in pieces weighing 10 to 15 grms. are placed in a platinum or porcelain combustion tube, connected with a potash apparatus containing a freshly prepared concentrated solution of pyrogallic acid—



in potassium hydroxide. The potash apparatus before the experiment is carefully weighed on a delicate balance. Next the combustion tube is gradually heated to a high temperature. In the same time through the tube and apparatus nitrogen is passed, obtained by the decomposition by heat of ammonium nitrite ( $NH_4NO_2$ ). Before passing this gas through the apparatus it is well dried by calcium chloride. The ignition of the steel in the tube must be continued for an hour, and next the apparatus is gradually cooled; the nitrogen meanwhile is also freely passed in order to avoid oxidation. The potash apparatus is next quickly weighed. The increase in weight of the apparatus will show the quantity of oxygen present in steel.

Experiments proved the existence of oxygen in very moderate quantities. Thus five specimens analysed gave 0.054, 0.037, 0.025, 0.040, 0.031 per cent of oxygen.

It would be of great interest if chemists undertook experiments in order to work out this question. My opinion is that in this case the oxygen is in an occluded state with steel, and even forms a certain chemical compound, very unstable, however, when heat is applied. It may be analogous to hydrogen palladium ( $Pd_2H$ ), which, by some chemists, is regarded as a chemical compound, and by others as a simply mechanical compound of palladium and hydrogen, the latter being only occluded in the metal.

Obouchoff Steel Works.

## PROCEEDINGS OF SOCIETIES.

RUSSIAN CHEMICAL SOCIETY,  
ST. PETERSBURG.

May, 1877.

A. WISCHNEGRADSKY, "On the Isomery of the Amylens." (Second paper). The author concludes the account of his researches on the amylen resulting from the action of alcoholic potash on amylic iodide, showing it to consist of a mixture of two hydro carbons.

W. ALEXEYEFF, "On the Reciprocal Solubility of Phenol and Water and of Amylic Alcohol and Water." The experiments were conducted by sealing weighed amounts of the substances in a glass tube and ascertaining

at what temperature they united to form a clear solution. The solubility of phenol in water increases at first in direct ratio with the temperature, then more rapidly, until at  $84^\circ$  it is soluble in all proportions. As no alteration in the increase of solubility takes place at the fusing point of phenol, it is considered that a change in the state of aggregation of a substance does not affect the solubility. The solubility of amyl alcohol in water decreases until a minimum at  $50^\circ$  is reached, and then ascends gradually. These facts are regarded as being in consonance with the hypothesis that an increase of the solubility with the temperature takes place only in the case of such compounds as form either a stable hydrate or no hydrate.

G. GUSTAVSON, "New Method of Introducing Bromine into the Aromatic Hydrocarbons in the presence of Aluminium Bromide." The author finds that by the slow addition of the aromatic hydrocarbons to an excess of bromide containing a small amount of  $Al_2Br_6$ , the complete replacement of the hydrogen atoms in the benzene skeleton,—although not in the side-links—is caused. The reaction is exceedingly violent, and must be performed in a cooling mixture. Benzene yields by this method, at  $0^\circ$ ,  $C_6Br_6$  quantitatively; toluen gives  $C_7Br_5H_3$ ; and mesitylen is changed into the tribromomesitylen of Fittig and Storer. By reversing the process, adding a limited quantity of bromine to a solution of  $Al_2Br_6$  in a hydrocarbon, any desired number of hydrogen atoms can be substituted. The method is a vast improvement on that hitherto used, of exposing the hydrocarbons to the action of Br and I at  $400^\circ$  for a length of time.

A. ELTEKOFF, "Structure of the Amylen boiling at  $25^\circ$ ." The experiments of Wischnegradsky showing this to be a mixture of two amylen, have been confirmed by changing them into bromides, and submitting the latter to the action of alcoholic potash. The results are valenylen boiling at  $35^\circ$ , and ethyl-valeryl-oxide, the latter of which could only be formed from the unsymmetrical melhyl-ethyl-ethylen.

I. SETSCHENOFF, "Absorption of  $CO_2$  by Blood." The chief results of the author's investigations are the following:—1. The serum of blood possesses a coefficient solubility for  $CO_2$ , not far removed from that of water, and can be considered, in that regard, as a weak solution of phosphate or carbonate of soda. The quantities of  $CO_2$  absorbed are, however, much more dependent on temperature and pressure. 2. The alkalies decomposed by the  $CO_2$  are albuminates containing paraglobuline. 3. The red blood cells possess a much greater coefficient of solubility than water. It is, however, much more affected by variations of temperature and pressure than that of serum, and these variations affect inversely the amounts of merely dissolved and of chemically combined  $CO_2$ . 4.  $CO_2$  is found in all cases in both serum and cells, the normal saturation in the veins corresponding to the absorption at  $37^\circ$  and 50 m.m. pressure.

## CORRESPONDENCE.

BISCHOF'S PAPER ON PUTRESCENT ORGANIC  
MATTER IN POTABLE WATER.

To the Editor of the Chemical News.

SIR,—Bischof's paper, which you quote from the *Proceedings of the Royal Society*, is deficient in novelty, and calculated to make an erroneous impression. The substance of the communication in question is that a certain kind of porous filter removes organic matter from drinking water with great completeness, and that animal charcoal does not.

Neither of these facts are new, and persons who are conversant with modern researches on filtration will be apt to ask, why was such a communication made to the Royal Society?—I am, &c.,

J. ALFRED WANKLYN.

Laboratory, 117, Charlotte Street, Fitzroy Square,  
London, W., July 7, 1877.

### NOXIOUS INSECTS: THE STAMPING-OUT PROCESS.

*To the Editor of the Chemical News.*

SIR,—The subject of insect and germ life in its relation to putrefaction and infectious disease is now assuming such importance from the investigation and demonstration of Dr. Tyndall, Mr. Murray, and other scientific inquirers, that I think you may consider the following curious facts not unworthy of space in your journal.

I observe in a report of Dr. Tyndall's lecture on "Germs," in the *Times* of Saturday, June 9, he refers particularly to the varying tenacity of life which germs under certain conditions exhibit, and which he refers to the period of incubation, or stage of development up to the state of emergence as complete organisms, when they are readily destroyed. He says, "We now turn to another aspect of the question. Following the plain indications of the germ theory of putrefaction, we sterilise in five minutes the very infusions which, a moment ago, were described as resisting five hours' boiling."

"The germs are indurated and resistant; the adult organisms which spring from them are plastic and sensitive in the extreme. The gravest error ever committed by biological writers on this question consists in the confounding of the germ and its offspring. The active bacteria developed from those obstinate germs are destroyed at a temperature of 140° F. Let us reflect on these facts."

"For all known germs there exists a period of incubation, during which they prepare themselves for emergence as the finished organisms which have been proved so sensitive to heat. If during this period, and well within it, the infusion be boiled for the fraction of a minute, even before the boiling-point is reached at all, the softened germs which are then approaching their phase of final development will be destroyed. Repeating the process of heating every 10 or 12 hours, each successive heating will destroy the germs then softened, until after a sufficient number of heatings the last living germ will disappear. If properly followed out the method of sterilisation here described is infallible; a temperature, moreover, far below the boiling-point suffices for sterilisation."

Now, as the laws of Nature apply to all magnitudes alike, whether it be a grain or a planet, whether to the various stages of incubation of the germs of bacteria or of noxious insect life, I think I may claim some credit for having stumbled upon, and for having applied on a practical and large scale, a system for eradicating insect life in animals, based on this law of varying tenacity of life in germs and insects.

More than two years ago I advocated this system, and in September last issued the following circular:—

"TO FLOCKMASTERS, FARMERS, AND GRAZIERS.

"GENTLEMEN,—In a circular which I issued some time since, I ventured to give a few suggestions on what I and others considered should be the right rules to be adopted in the important matter of cleansing sheep from noxious insect life, and at the same time I stated that I believed, by systematic treatment, much of this insect contagion might be stamped out. I will now briefly give my own experience, derived from the management of a flock of between 600 and 700 old sheep and lambs.

"A short time after clip-day, I dipped by immersion the young lambs, and I repeated the same before harvest. At the same time I made a long narrow pen alongside the stackyard fencing, into which I crammed all my old sheep as close together as possible. I then, with an ordinary watering-pan, watered then all over with diluted fluid; the latter operation was completed in half-an-hour, and the cost in material was less than ½d. per head, the proportions in both cases being 1 to 100. Now for results. Only yesterday I minutely examined the whole of my sheep, for the purpose of deciding if it was necessary to give them a final dressing before October; and I can now, frankly and without hesitation, state that in the whole flock, old and young, I could not find a single living insect, or the germ of one, although at the same time last year, in consequence of using the old-fashioned arsenical material, my sheep swarmed with filth. I shall now, of course, let well alone, under the conviction that my sheep will keep perfectly clean up to next clip-day; at all events I shall closely watch them, and whatever the results may be I will again trespass on your attention by a candid statement of facts. To sum up, it would appear that the correct system is to kill the present generation of insect life, and about a month or six weeks after, when their eggs have germinated, to attack the rising generation, and thus 'stamp them out' altogether."

In the month of March last, agreeable to my promise, I issued a faithful report of the results of this system for stamping out insect life, which I enclose, but in case it should be too long for your valuable space, I may briefly say my hopes were completely realised, every insect pest was stamped out; and hundreds of persons inspected my flock, which was absolutely clean.

I believe I may say there is exact analogy between this system for exterminating insect life in animals and that adopted by Dr. Tyndall, to show that the earliest eggs or germs of bacteria are extremely obstinate to kill, whilst the fully developed are destroyed without difficulty; clearly showing that more than one treatment is necessary for the complete destruction of germ life as well as for a higher form of insect life, and that the same law applies to both alike.

I am fully convinced of the possibility of stamping out noxious insects that affect sheep and other animals, and sincerely hope Mr. Murray's suggestion at the Society of Arts—of united action to effect this purpose, under the direction of science and experience—may be acted upon with little delay.—I am, &c.,

W. LITTLE.

The Hall, Heckington, Lincolnshire.

PS.—I shall be glad to send the report to any of your readers who may desire to see it.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 24, June 11, 1877.

Densities of Vapours; a reply to M. H. Sainte Claire Deville.—M. Ad. Wurtz.

Atomic Notation; a reply to M. Berthelot.—M. Ad. Wurtz.—These two papers are further contributions to the controversy which has now been raging for some time between this author and the two distinguished chemists above-mentioned.

Rotatory Polarisation of Quartz.—MM. J. Soret and E. Sarasin.—The authors have previously communicated

to the Academy the results of their researches on the rotatory polarisation of quartz for the different rays of the solar spectrum from the ray A to R. They have now extended their investigations to the ultra-violet rays of a still greater refrangibility.

**New Electric Lamp with Oblique Circular Rheophores.**—M. E. Reynier.—The author's object has been to produce an electric lamp capable of acting for 24 hours. He has succeeded in almost completely suppressing the occultations hitherto supposed inherent in the use of discs. M. Cance submitted to the Academy a novel system of electro-magnets with a multiple nuclei, analogous to that of M. Camacho, but in which the tubular nuclei are replaced by series of small rods of soft iron in juxtaposition and enveloping in pairs the different layers of spirals.

**Use of Electro-Magnetic Machines with continuous currents.**—M. Gramme.—The author infers from his experiments that in electro-metallurgical operations it is more economical to arrange the baths for tension than for quantity. M. Jamin on presenting M. Gramme's paper remarked that M. A. Thenard had previously communicated experiments proving that the total amount of copper deposited by a Gramme machine is increased considerably by directing the current through a series of baths whilst the sum of the deposits remains sensibly constant when the baths are arranged not for tension, but for quantity.

**Influence of a Mechanical Action on the Production of Various Hydrates in Supersaturated Solutions.**—M. D. Gernez.—The author finds that if a rigid rod is introduced into a supersaturated solution, or rubbed against the sides of the vessel below the level of liquid, the formation of crystals may be determined. M. Gernez specifies three cases; crystals of the least hydrated salt may be produced, as when clear and very concentrated solutions of the sulphate of soda below 8° are thus treated. Secondly, there are produced crystals of the most hydrated salt in solutions where, nevertheless, the other hydrate may be formed by the introduction of a crystalline germ. This takes place with the acetate of soda. Or thirdly, either hydrate may be produced according to the intensity of the mechanical action. This case has been observed in concentrated solutions of chloride of calcium.

**New General Method for the Synthesis of Acetones, Hydrocarbides, &c.**—MM. C. Friedel and J. M. Crafts.—The authors mix an organic chloride, iodide, or bromide with a hydrocarbon and add chloride of aluminium in small portions. Thus having mixed benzol with iodide of ethyl and added chloride of aluminium they obtained ethyl-benzol, boiling between 135° and 137°.

**Researches on Normal Propylen.**—MM. E. Reboul and E. Bourgoïn.—The authors find that the electrolysis of pyrotartaric acid does not yield trimethylen, allylen, ethylen, or acetylen.

**Composition of a Substance formed on an iron rod affected by the gases of a Siemen's Furnace.**—M. A. Terreil.—The substance in question contains:—

Iron as protoxide	.. .. .	62.46
„ as peroxide	.. .. .	13.19
„ as sulphide	.. .. .	0.54
Oxygen	.. .. .	23.46
Sulphur	.. .. .	0.31
Silica	.. .. .	traces

99.96

M. Daubree considered that this substance afforded fresh proof of the extreme permeability of solids, such as baked clay or crystalline ferrous oxide to gases, a property which may be applied to various geological facts, and especially to certain phenomena of metamorphism.

*Bulletin de la Societe Chimique de Paris,*  
No. 7, April 5, 1877.

**Reduction of Mercury in California.**—M. Paterna.—The cinnabar is converted into calomel by the action of copper chloride; the calomel is dissolved in hyposulphite of soda, and sulphide of mercury is then precipitated by sulphide of sodium. The process is tedious and costly. Sieverking describes another process in the *Mining and Scientific Press* of San Francisco. He places the ground ore in casks with granulated copper, or, preferably, an alloy of copper and zinc, and agitates the mixture for twelve hours with a hot solution of cupric chloride. When a sample taken out shows the total decomposition of the cinnabar, a small quantity of zinc amalgam is added which effects the precipitation of all the copper which has remained in solution and causes the agglomeration of that portion of mercury which had been deposited in a pulverulent state. The agitation is continued for some time; the casks are then filled with water and allowed to settle. The amalgam, which is very compact, subsides; the liquid is carefully decanted and distilled; the residue from this distillation serves for the preparation of chloride of copper for succeeding operations.

No. 8, April 20.

**Reaction between Nitrogen and Water.**—M. Berthelot.—The author has repeated with an affirmative result experiments on the formation of the nitrate of ammonia under the influence of the electric effluve. The result, however, cannot be produced under the influence of weak electric tensions.

**Constitution of Salts and Acids in Solution.**—M. Berthelot.—Not suitable for abstraction.

**Influence of Pressure upon Chemical Phenomena.**—M. Berthelot.—The development of hydrogen by the action of dilute acids upon zinc is not assisted by pressure but merely retarded.

**Transformation of Pyrotartaric Acid into Dibromopyrotartaric and Dibromosuccinic Acids.**—MM. E. Reboul and E. Bourgoïn.—Not suitable for abstraction.

**Metal which accompany Iron.**—M. A. Terreil.—Reserved for insertion in full.

**Sulphide of Manganese.**—MM. Ph. de Clermont and H. Quiot.—Already noticed.

**Certain Amides of the Naphthyl-Sulphurous Acids.**—M. J. A. Carleson.—By the action of ethylamin, aniline and naphthylamin upon the chlorides of the  $\alpha$ - and  $\beta$ -naphthyl-sulphurous acids the author has obtained  $\alpha$ - and  $\beta$ -ethylamide,  $\alpha$ - and  $\beta$ -anilide, and  $\alpha$ - and  $\beta$ -naphthylamide.

**Reten-Sulphurous Acids.**—A. G. Ekstrand.—Not adapted for abstraction.

**Certain Compounds of Mercuric Cyanide with the Chlorides of the Earthy Metals.**—M. J. E. Ahlen.—The salts in question have been obtained by allowing a solution of mercuric cyanide to crystallize along with an excess of the chlorides of cerium, lathanum, didymium, yttrium and erbium.

**Molecular volumes of Isomorphous Salts.**—M. O. Petterson.—The author has examined many double salts of the alum group, the sulphates and seleniates of the earthy metals.

A number of papers on organic chemistry, all taken either from *Liebig's Annalen*, or from the *Berichte der Deutsch. Chem. Gesell.*, and the technological notes which follow are all from the *Comptes Rendus*.

*Bulletin de la Société d'Encouragement pour l'Industrie Nationale.* May, 1877.

Report presented by M. Duméz on behalf of the Committee of Mechanical Arts, on an Electric Clock presented by M. de Laguerenne.

Report on the Improvements introduced by M. de Laguerenne in his Electric Clock.—M. Th. du Moncel.

These papers would be unintelligible without the accompanying figures.

Statistics of the Glass Trade.—M. H. de Fontaine.—The total annual value of the glass manufactured in Europe and America has almost doubled during the last twenty years, and amounts now to six hundred millions of francs.

On the Mines of Japan.—Taken from the *Quarterly Journal of Science*.

June, 1877.

This issue contains no original chemical matter.

*Reimann's Färber Zeitung*, No. 22, 1877.

The chemists employed by the sanitary authorities of Sweden are said to have used improper methods for the detection of arsenic in various dyed and coloured articles, such as woollen and cotton goods, lamp-screens, paper, confectionery, &c. As a large portion of the condemned articles are said to have come from Germany, the affair has led to a correspondence between the Swedish Department of Foreign Affairs and the German Ambassador. According to the Berlin papers a pianoforte manufacturer has died of blood-poisoning in consequence of having bound up a cut on his finger with a piece of leather dyed with Schweinfurt green!

Eosin.—A. Baeyer has given certain additional particulars as to the manufacture of eosin. Fluorescein is obtained by heating 5 parts of anhydrous phthalic acid to 200° along with 7 parts of resorcin. The mass swells up and solidifies in the course of three to six hours. Fluorescein is extracted from this crude product by boiling with alcohol. It is a feeble acid, and dyes silk and wool a fast yellow with a reddish cast. For the preparation of eosin the fluorescein is suspended in 4 parts of glacial acetic acid and solution of bromine in glacial acetic acid, containing 20 per cent of the former is added. Tetra-brom-fluorescein (eosin) separates out in red crystals.

No. 23, 1877.

The property of zinc-powder of liberating an intense heat when moistened, has placed a ship, which contained a cask of this article in great peril of fire.

No. 24.

New Formation of Rosanilin.—Dale and Schorlemmer produce rosaniline by heating red aurin to 150° for several days along with ammonia. The details of the process are given in the *Berichte der Deutschen Chemischen Gesellschaft*, 1877, 10.

According to the *Bulletin de la Soc. Indust. de Rouen* Collin produces a soluble aniline black by heating together to 200° degrees for five hours; a mixture of 6 grms. oxalic acid, 5 grms. aniline, 2 grms. sulphate of iron, and 3 grms. nitrobenzol. The liquid dyes cotton a grey, and wool a black, deficient in intensity.

No. 25, 1877.

The extract of chestnut-wood is coming more widely into use as an astringent in dyeing and tanning.

Dr. Reimann still complains of the piratical conduct of a Belgian contemporary.

*Les Mondes, Revue Hebdomadaire des Sciences*,  
No. 5, May 31, 1877.

This issue contains no original chemical matter.

No. 8, June 21st, 1877.

A statue of Arago will soon be erected at Perpignon. The municipal council of Chalons is collecting funds to do homage in like manner to the memory of Niepce de St. Victor, and a statue of Ampere is in contemplation at Lyon.

Lighting with Resin.—M. Pallas considers that the use of the volatile essences distilled from resins depends upon the construction of a suitable lamp.

M. Berthrand and M. Guyot contribute papers on the excessive or imprudent use of tobacco, and on the presence of carbonic oxide in the products of its combustion.

## COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

JUNE, 1877.

THE following are the returns of the Society of Medical Officers of Health:—

Appearance in 2 foot Tube.	Ammonia.		Nitrogen as Ni- trates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Sulphuric An- hydride.	Hardness on Clark's Scale	
	Saline.	Organic.								Before Boiling.	After Boiling.
	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
<i>Thames Water Companies.</i>											
Grand Junction .. ..	Turbid	0'001	0'008	0'129	0'050	18'40	7'500	0'360	0'94	1'660	11'0 4'2
West Middlesex .. ..	Clear	0'000	0'007	0'129	0'054	17'70	7'280	0'320	0'94	1'600	12'6 3'3
Southwark and Vauxhall	Turbid	0'001	0'009	0'108	0'064	18'90	7'720	0'360	0'87	1'730	12'6 3'0
Chelsea .. ..	Clear	0'002	0'009	0'090	0'076	18'80	8'000	0'360	1'01	1'330	13'2 3'3
Lambeth .. ..	Turbid	0'000	0'008	0'150	0'074	19'90	8'170	0'460	1'01	1'600	13'2 3'7
<i>Other Companies.</i>											
Kent .. ..	Clear	0'000	0'002	0'450	0'003	28'70	11'310	0'680	1'59	4'130	19'4 7'0
New River .. ..	Clear	0'000	0'006	0'150	0'033	18'20	8'060	0'430	0'97	1'330	12'6 3'3
East London .. ..	Clear	0'000	0'007	0'090	0'047	17'80	7'320	0'460	1'01	1'330	12'0 3'3

The quantities of the several constituents are stated in grains, and calculated in 70,000 grains of water or 1 imp. gall

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY.

## MISCELLANEOUS.

University of London.—The following is a list of candidates who have passed the recent DSc. Examination:—BRANCH IV. Inorganic Chemistry—John May Herbert Munro, Royal College of Science, Dublin. BRANCH VI. Electricity (Treated Experimentally)—Oliver Joseph Lodge, University College. BRANCH VIII. Physical Optics; Heat; Acoustics (Treated Mathematically)—John Frederic Main, Trinity College, Cambridge. BRANCH X. Comparative Anatomy:—Arthur Milnes Marshall, B.A., St. John's Cambridge, and St. Bartholomew's Hospital. BRANCH xiv. Geology:—Walter Saise, Royal School of Mines.

Royal School of Mines.—*Associates in Mining and Metallurgy*:—C. W. Folkard, A. K. Huntington, C. W. Voelcker. *Associates in Mining*—C. H. Liveing, W. H. Merritt. *Associates in Metallurgy*—A. C. Copeland, J. F. Hogan, C. H. Lemann, W. Leyson, E. T. McCarthy. *Associate in Geology*—A. R. Sawyer, A.R. The Edward Forbes medal and prize of books was awarded to A. Heilprin. The De la Beche medal and prize of books to E. W. Voelcker. The Murchison medal and prize of books to F. G. Mills.

## NOTES AND QUERIES.

Free Oxygen in Water.—I shall feel obliged if any reader of the CHEMICAL NEWS will favour me by giving an easy and trustworthy method of estimating the free oxygen dissolved in water.—F.R.S.

Bisulphide of Carbon.—How many manufacturers are there in this country? What is the wholesale price per ton, and who are the chief users? Is there a market for the pure article, and what is its price per ton?—METHYLAMINE.

Egg Albumen and Blood Albumen.—Where can I obtain particulars as to manufacture of above? I have consulted Encyclopædias, but can find no details. How is the raw material to be obtained in quantity? What is the process and machinery, and what are the applications of the manufactured article? Can any reader assist me in these queries?—X. Y. Z.

## TO CORRESPONDENTS.

E. S. G.—Your questions are not suitable for our "Notes and Queries" column. The first is not intelligible, and there is not a book written on the second.

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# THE CHEMICAL NEWS.

VOL. XXXVI. No. 921.

## ON REPULSION RESULTING FROM RADIATION.—PART IV.\*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 15.)

186. In a former paper on this subject, communicated to the Royal Society, March 20, 1875, I gave some rough observations (110, 111) on the effect of the different rays of the electric and solar spectrum on the horizontal torsion-balance (102); and in a note (111) I said, "Every thing is ready to try a series of experiments with the solar spectrum, as soon as sunshine is available. The results shall be communicated in a subsequent paper."

The apparatus which I have now used for this purpose is shown in figs. 12 and 13. Fig. 12 shows the horizontal

To the centre of *a b* an upright tube (*e f*) is sealed, having an arm (*g*) blown on it for the purpose of attaching the apparatus to the pump. *h i* is a glass index drawn from glass tubing, and as light as possible consistently with the needful strength. A long piece of this tube is first drawn out before the blowpipe, and it is then calibrated with mercury until a piece is found having the same bore throughout; the necessary length is then cut from this portion. *j k* is a very fine glass fibre, cemented at *j* to a piece of glass rod, and terminating at *k* with a stirrup, cut from aluminium foil, in which the glass index (*h i*) rests. In front of the stirrup is a thin concave glass mirror, shown at *k*, silvered. The suspending thread is selected of the proper stiffness by the method given in par. 103. The small glass rod hung on to the end of the fibre to test its torsion weighs 15.46 grains; its length is 90 millims., and its external diameter 3 millims. The selected fibre, having this glass rod suspended to it in air, was found to vibrate half oscillations in 35 seconds.

The weight of the beam with the blackened pith ends is 0.891 grain; the mirror and stirrup by themselves weigh 0.87 grain; therefore the whole beam, as suspended, weighs 1.761 grain. The length of the beam from centre to centre of the pith squares is 147.5 millims. This beam is so light, and the pith surfaces are so large, that its

FIG. 12.

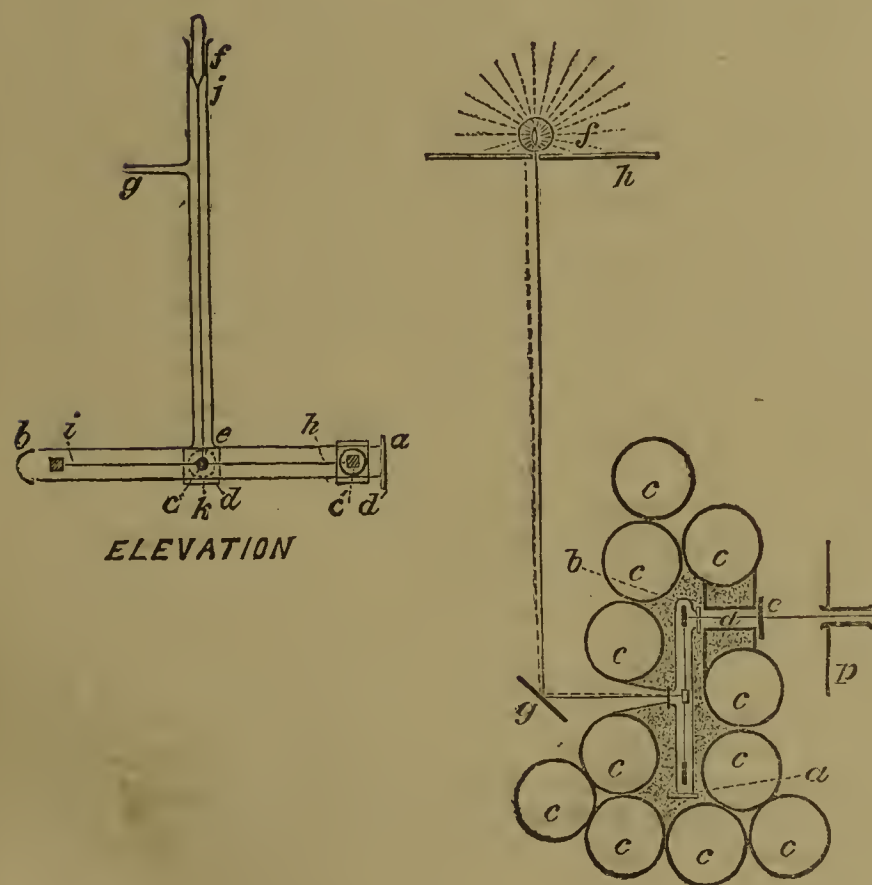
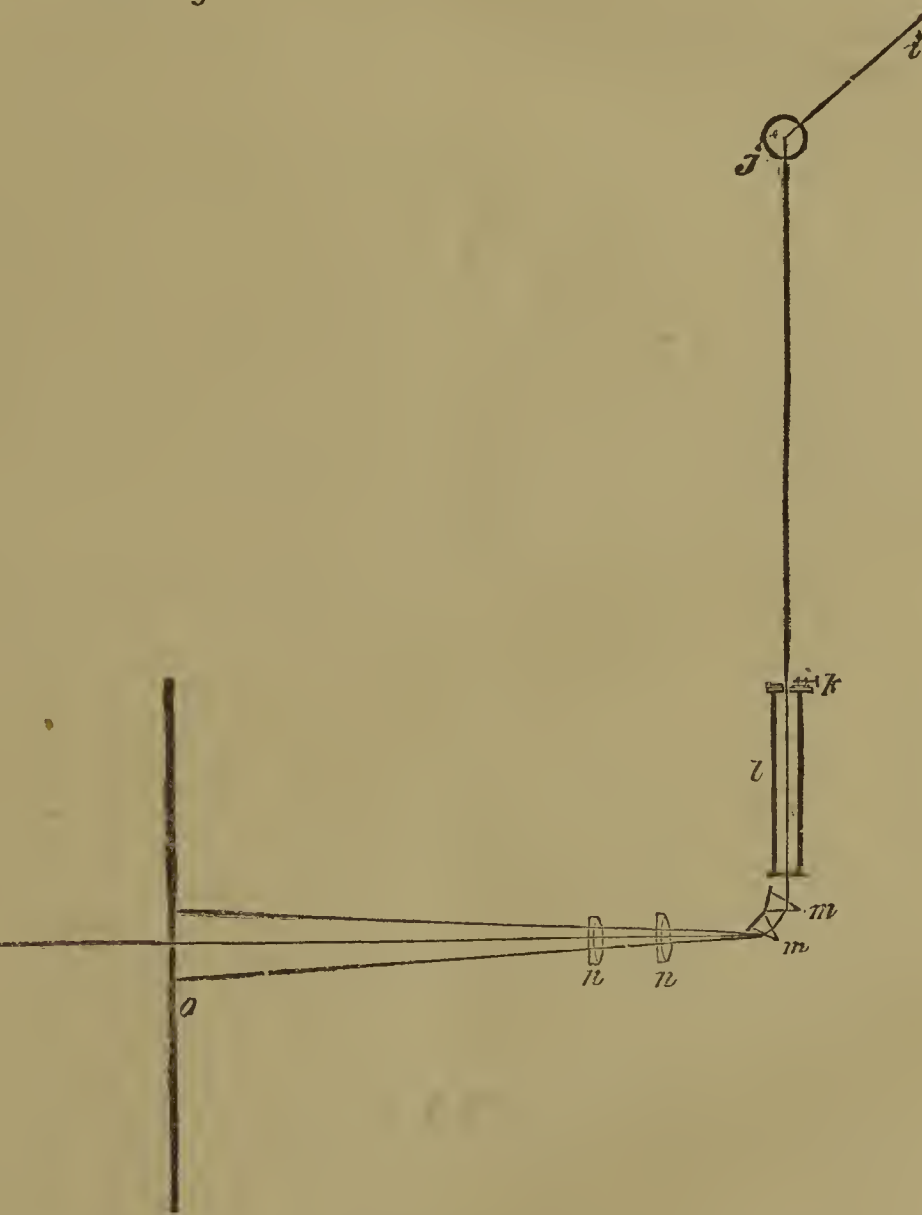


FIG. 13.



torsion-balance; it is similar in appearance to the one described in par. 102. *a b* is a piece of thin glass tubing, sealed off at the end *b*, and ground perfectly flat at the end *a*. In the centre a circular hole (*c*) is blown, and another one (*c'*) at the end, the centre hole being at the back, and the one at the end in front. The edges of these holes are ground quite flat. *a*, *c*, and *c'* can therefore be sealed up by cementing flat transparent pieces of plate glass, quartz, rock-salt, &c. (*a*, *d*, and *d'*) on them.

vibration in air, when suspended from the glass fibre, cannot be timed. Therefore to ascertain what the torsion of the fibre is with that weight suspended on it, I cemented a piece of platinum weighing 1.543 grain (1.10th gramme) to the fibre, cut to the proper length, and timed its oscillations. 10 half-vibrations were taken by a chronograph. The times recorded during three experiments were—

9.5 seconds, 9.6 seconds, 9.6 seconds;

so that *in vacuo* the beam ought to take about two seconds for each complete oscillation.

\* A Paper communicated to the Royal Society, February 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

The pith surfaces at the ends of the beam are 13 millims. square; they are very thin, and are lampblackened on the surface. The window in the centre (*d*) is of plate glass, the window at *d'* is of quartz. They are on opposite sides of the apparatus, as will be better seen by referring to fig. 13.

187. When fitted up for spectrum observations the whole arrangement is shown in Fig. 13. *ab* is the torsion-apparatus, shown in plan, the pith disks being represented by black lines at the ends of the central fine line representing the beam. The suspended mirror is shown in the centre of the beam. The quartz window is shown at the end *b*, and the other window opposite the central mirror. *c, c, c* are Winchester quart bottles full of water, and each encased in brown paper to prevent it accidentally acting as a lens, and condensing light on any part of the apparatus. Between the bottles, and surrounding the apparatus on all sides, as well as above and below, cotton-wool is well packed, spaces being left only for the rays of the spectrum to pass to the pith disk, and for the index ray of light to pass to and from the mirror. The cotton-wool acts as an excellent non-conductor of heat, and also prevents air-currents. The water in the bottles keeps the apparatus of a nearly uniform temperature, and entirely prevents sudden changes. *d* is a cardboard tube, blackened inside, for the light to pass along; it has a movable shutter (*e*) at the outer end, which can be opened or closed by a touch of the finger without shaking the apparatus. The torsion-balance is firmly fastened to the walls of the room, which are very thick and firm, whilst the bottles and rest of the apparatus are supported by the floor; vibration caused by walking about or touching any of the other pieces of apparatus is therefore not communicated to the torsion-beam. *f* is a small lamp, a ray from which, passing through a narrow slit, falls on the inclined mirror (*g*), whence it is reflected to the suspended mirror of the torsion-apparatus. The light is now reflected back again to the mirror (*g*) and the graduated scale (*h*), where its position indicates the movements of the torsion-beam. The mercury-pump (not shown in the figure) is at some distance from the apparatus, so that the radiation from my body might not affect the apparatus when the pump was set working.

The ray of sunlight (*i*) falls first on the silver mirror (*j*) of a heliostat moving by clockwork; thence it is reflected to the slit *k*, along the tube *l*, through the prisms *m*, and the lenses *n*. *o* is a large screen, with a narrow vertical slit in it, so as to allow only the part of the spectrum I wished to experiment with to pass on to the apparatus. *p* is another screen extending for a considerable distance, and intended to prevent extraneous light from entering the apparatus when the shutter (*e*) is opened. It has a square aperture of such a size that a beam of light passing through it will just cover the pith surface (13 millims. square). The slit was kept half a millimetre wide during the experiments; the focus of the lenses was so adjusted as to form a sharp image of the spectrum lines at the place occupied by the square of pith on the torsion-beam. The slit and prisms are on a firm stand, capable of rotating through a small angle on a centre near the prisms. By this means any desired portion of the spectrum can be thrown on the pith without disturbing the focus. This necessitates an alteration in the adjustment of the heliostat, but that is soon effected. Slight alterations in the position of the spectrum can be made by moving one or both of the lenses sideways.

The distance between the slit and prisms is 16 inches; from the prisms to the pith surface is 7 feet 8 inches. The length of the spectrum here is 200 millims. from the lines A to G. The apparatus was fitted up in a room which admitted the sun in the right direction from about 10 a.m. to half-past 1 p.m. The heliostat was sufficiently good to keep a beam of light on the apparatus the whole of that time.

(To be continued.)

## ON THE DETERMINATION OF THE ORGANIC MATTER IN POTABLE WATERS.\*

By W. DITTMAR and H. ROBINSON.

IN the analysis of a potable water the most important element to be determined is the quality and quantity of the organic matter, but unfortunately the direct solution of this problem is, and probably for a long time will remain, beyond the range of the resources of chemical science. All that we possess at present are those two indirect methods proposed about the same time ten years ago; the one by Messrs. Wanklyn and Chapman, the other by Drs. Frankland and Armstrong, and which generally go by the names of "Frankland's process" and "Wanklyn's process" respectively. Both these methods are universally known in all their details; but, that being so, it is surprising to see, and utterly inexplicable on scientific grounds, that so many chemists—especially Mr. Wanklyn and Dr. Frankland themselves—look upon the two methods as quite directly competing with each other; so that, assuming one of them to be proved the better, the other has no *raison d'être*. It is true, if organic matter to be determined could be approached only by proximate analysis on the one hand or ultimate analysis on the other, and if Mr. Wanklyn gave out his albuminoid ammonia process as a means for determining the total organic nitrogen, Dr. Frankland would clearly be in the right and Mr. Wanklyn in the wrong. But nobody would suspect Mr. Wanklyn of looking upon his permanganate process as being anything more or less than a particular form of his method of "limited oxidation"—one of the many ways, in fact, in which organic matter may be questioned by the quantitative application of generic disintegrators. Now, after the many critical experiments made by Messrs. Wanklyn and Chapman, nobody can reasonably deny that Wanklyn's "albuminoid ammonia," although in general rather a complex quantity, bears a definite relation to that part of the nitrogen of a water which exists in certain states of combination, and consequently is a result worth booking, in addition to the total organic nitrogen; while Mr. Wanklyn himself, on the other hand, would surely be the last to deny that his method, in its present form, is far from being so absolutely constant in its results as not to be all the better for being supplemented by a determination of the organic carbon and total organic nitrogen. Clearly the two methods, far from being antagonistic, are destined to supplement each other. No doubt all analysts would soon come to take this view of the matter and act upon it, if it were not for the fact that Frankland's method, although certainly not difficult, is very slow of execution, and involves the use of cumbrous, costly, and easily-deranged apparatus. What is wanted is so to modify Frankland's process as to considerably shorten it and bring it within the range of ordinary laboratory appliances. This problem seemed to us worth working at, and we accordingly devoted to it part of last summer's holidays; but through various circumstance we were compelled to shelve the subject for a considerable time, and it was only lately that we got the experiments completed.

### Determination of the Organic Carbon.

The idea which guided us in the experiments to be recorded under this head was that Frankland's process might be considerably shortened, without any loss of precision, by devoting to this determination a separate quantity (say about a litre) of the water, and—

1. Doing the greater part of the concentration by boiling down with sulphurous acid in a slanting flask; and—

\* Read before the Chemical Section of the Glasgow Philosophical Society, April 30th, 1877.

2. Determining, by combustion, the carbon in the residue by a proper modification of the ordinary gravimetric, instead of Frankland's troublesome gas-volumetric, process.

\* About the first point we had at first some serious misgivings, which, however, we are now able to say, after considerable experience, proved unfounded. The practicality of the second point, on the other hand, seemed to us almost self-evident, but it was precisely the one which gave us the greatest amount of trouble to settle.

The *modus operandi* we adopted for the combustion differed in very little from the customary one:—The residue—obtained by boiling down, in a slanting glass flask, a mixture of the water and sulphurous acid, and evaporating to dryness in a glass vessel on a water-bath—was mixed with a convenient quantity of chromate of lead, the mixture introduced into a combustion-tube about 8 to 9 m.m. wide inside and 30 c.m. long,—previously drawn out at one end into a bayonet-shape,—a reduced copper-gauze spiral placed in front of the mixture, and the combustion conducted in a current of air supplied by a glass gas-holder charged with dilute caustic soda. For the absorption of the water we used a little V-shaped tube containing 60 per cent sulphuric acid, with which was united permanently a short tube filled with granulated chloride of calcium. From this apparatus the product passed through a small, and consequently light, soda-lime tube (having, of course, a layer of chloride of calcium, at its exit end), for the absorption of the carbonic acid. The balance we used was a fine Oertling, which, when moderately charged, was constant in its indications to within less than 1-10th m.grm. The tare of the tube proved perfectly constant; hence the CO<sub>2</sub> weights observed could be assumed to be correct to within 1-10th, or at most 1-5th, of a m.grm.—equal respectively to 1-40th or 1-20th of a m.grm. of carbon. And this degree of precision is quite sufficient, so that it is needless to enquire whether Frankland's volumetric *modus* would go further—which we beg leave to question.

When we came to test this method by rehearsals with small known weights of pure substances we were surprised to find that our results were all too high. Thus, for instance,—

7.69 m.grms. sulphate of quinine\* gave 18.4 m.grms. CO<sub>2</sub>, instead of 15.5.  
10.64 m.grms. hippuric acid gave 24.56 m.grms. CO<sub>2</sub>, instead of 23.54.  
8.37 m.grms. hippuric acid gave 21.35 m.grms. CO<sub>2</sub>, instead of 18.51.

Where did this excess of carbonic acid come from? The chromate of lead which had been used seemed safe and sound. We had not prepared it ourselves, but its appearance showed it had gone through a thorough process of fusion; besides, before being considered fit for use, it had been powdered, kept at a dull red-heat in platinum for a considerable time, and then preserved in a glass-stoppered bottle covered with a glass shade to keep off dust. To get at the source of the error we carried out a systematic series of blank experiments, which soon brought the result that the piece of india-rubber tubing which had been used to join the gas-holder to the combustion-tube gave up enough of carburetted hydrogen vapour to the air to furnish, when burned and sent through baryta-water, an appreciable precipitate. So, thereafter, we made it a strict rule never to use more india-rubber for any joint than was absolutely necessary for producing a sufficient degree of flexibility. When the air was now passed through the empty tube, at a red-heat, the baryta remained clear; but when the experiment was repeated with chromate of lead in the tube there was a *dense* precipitate of carbonate formed. We accordingly re-fused our chromate in a platinum crucible, and kept it at a bright red-heat

until part of the oxygen had boiled off, poured the liquid mass into a platinum dish, pounded it in a porcelain mortar, and immediately bottled it up. But even with such chromate the baryta-water became as muddy as ever. We then prepared chromate of lead ourselves by decomposing bichromate of potash with nitrate of lead, washing the precipitate by decantation only, drying it in a porcelain basin, and heating it in a small porcelain dish within a Griffin's muffle to the highest temperature which could be used without fusing it. But this preparation also, when heated in air, gave off large quantities of carbonic acid. We next fused this chromate, but it did no good. We were thus forced to the conclusion that chromate of lead, even when free from excess of oxide (PbO), eagerly absorbs carbonic acid from the air or the flame-gases, which cannot be expelled by mere heating in a crucible. There is, however, a way of getting a safe chromate: it consists in taking the ordinary preparation, and heating it in a combustion-tube to redness in a current of pure air until it ceases to give off anything that renders baryta-water turbid, and to use the product *immediately* for the combustion to be made. In this manner the following analyses were made:—

	Substance.	CO <sub>2</sub> found.	CO <sub>2</sub> calculated.
1.	5.700 m.grms. mannite	8.26	8.26
2.	6.200 " "	9.10	8.94
3.	3.316 " urea	2.43	2.43
4.	3.316 " "	2.80	2.43
5.	3.316 " "	2.20	2.43

The urea in experiments 3, 4, and 5 was weighed indirectly by measuring off the proper volume of a standard solution. In No. 3 the solution was evaporated to dryness, with addition of a pinch of sulphate of potash in order to obtain a sufficient body of residue: in the case of Nos. 4 and 5 the urea was dissolved in 500 c.c. of pure water, the solution mixed with 75 m.grms. of common salt, 16 m.grms. of anhydrous carbonate of soda, 5 m.grms. of acid sulphite of soda, and 30 c.c. of a strong aqueous solution of sulphurous acid; the whole boiled down to a small bulk in a slanting flask, and the residue evaporated to dryness in a basin covered with a screen of filter-paper on a water-bath. The results, although not quite so exact as we could have wished, are sufficiently near the truth for practical purposes: at any rate it was not the method of combustion used which caused their relatively high values (+0.37 and -0.23 m.grm. in CO<sub>2</sub>, or +0.1 and -0.06 in C).

We next tried oxide of copper instead of chromate of lead. The result was that the oxide, although it contained carbonic acid after having been kept for a long time, even in a glass-stoppered bottle, readily gave up its carbonic acid on ignition in a muffle, and then, when carefully preserved, remained all safe for a week or fortnight at least.

Unfortunately Dr. Frankland's lecture on Water Analysis (*Chem. Soc. Journal* for 1876, p. 825), in which he recommends oxide of copper instead of chromate of lead, without saying why he made the change,—for he prescribed the use of chromate in his original memoir, and again in his paper in vol. vi. of the "Rivers Pollution Commission,"—came to hand only after we had finished our work, or it would have saved us a considerable amount of trouble.

On looking back upon our experiments now, it strikes as that the loss of time and the trouble involved in our method of carbon determination could probably be reduced to a minimum by something like the following *modus operandi*:—Take a combustion-tube wide enough to accommodate a conveniently-sized platinum boat; charge it with (1) a spiral of silver\*-wire gauze, (2) a layer of granulated oxide of copper, and, after having attached our water-absorption apparatus (of which the V-shaped part

\* 0.5 grm. of which gave 0.1349 of sulphate of baryta = 9.26 per cent of SO<sub>3</sub> instead of 9.19.

\* A German chemist, whose name we forget, found some years ago that red-hot silver reduces nitrogen oxides as effectively as copper does; of course, without itself suffering permanent change.

should be charged with a solution of chromic acid in 60 per cent sulphuric, to absorb the sulphurous acid that must be expected to come over), heat the silver and oxide of copper to redness in a current of carbonic acid-free air, until the air as it comes out no longer precipitates baryta-water. Now introduce the boat charged with the water-residue, attach the tared soda-lime tube, and execute the combustion as usual. At the end of the analysis the tube would be ready for another combustion.

#### Determination of the Organic Nitrogen.

In the execution of this determination one of the difficulties to be overcome is the thorough elimination of the nitrogen of the nitrates and nitrites. In regard to this problem we are glad to be able to confirm the experiences of Drs. Frankland and Armstrong, and to say that we found their method to work satisfactorily (evaporation with sulphurous acid and a little iron-salt). This point being settled, it seemed to us that the determination of the organic nitrogen of a water might easily be effected in the following manner:—Starting with, say, half a litre of water, boil it down in a pear-shaped flask connected with a Liebig's condenser (taking care to avoid overheating the empty part of the flask), and "Nesslerise" the ammonia as it comes over. With a little experience it is quite easy in this manner to concentrate the water to about 25 c.c. without overheating any of the dissolved matter. We may also give it here at once as the result of our present experience that the ammonia is all contained in the first 100 to 150 c.c. of distillate. After having thus got rid of 19-20ths of the water, add the requisite quantity of sulphurous acid and ferric chloride, and, if necessary, something to give body to the residue—we usually employed sulphate of potash; complete the evaporation with the necessary precautions on a water-bath, burn the residue with soda-lime, collecting the ammonia in highly dilute hydrochloric acid, and determine it colorimetrically according to Wanklyn and Chapman.

When we proceeded to rehearse this method our difficulties with chromate of lead were still fresh in our memory, and we were therefore not over-much surprised that even when we worked upon pure ammonia-free water, or solutions in such water of small quantities of nitrate of potash, the distillates obtained on combustion contained very appreciable quantities of ammonia. We shall not trouble the reader with an account of the many experiments we made to ascertain the source of this ammonia: suffice it to state that we succeeded in almost absolutely eliminating the error by an improved construction of our water-bath, and by a peculiar modification of Varrentrapp and Will's method of nitrogen determination. Our water-bath may be shortly described by saying that it is a slight modification of Dr. Bischof's well-known apparatus, from which in fact it essentially differs only in this—that the steam is sent back into the boiler by an inverted condenser, and that the basin is connected with the bath by means of a mercury valve, so that, although the steam strikes directly against the basin, none of it can get into contact with the contents of the basin, which is nevertheless directly heated by the steam, and consequently maintained at the highest possible temperature. The mercury valve worked most satisfactorily; but we do not describe it because we used it merely as a makeshift to be replaced by a solid metal joint, *i.e.*, a conically-ground ring of brass cemented to the basin, and fitting into a corresponding conical socket on the bath. Our evaporating apparatus stood in a separate room, not communicating with any other room, and by observing certain obvious precautions we easily avoided the breathing of mercury vapours, which, in fact, as long as the bell-jar is in its place, cannot get into the laboratory; but, after all, mercury vapours are not to be trusted, and had better not be produced unnecessarily.

Our method of combustion consists in this—that we place the water-residue in a large copper or silver boat,

moisten it with a drop of water, place on it about 3 grms. of a fused mixture of equal weights of pure baryta ( $\text{Ba}(\text{HO})_2$ )\* and sodium-soda, and, after having introduced the boat into a short combustion-tube by the exit end with an absorption apparatus charged with highly dilute hydrochloric acid water, very gradually heat the boat—ultimately to dull redness—in a current of hydrogen, when the nitrogen is all eliminated as ammonia, which is easily measured with a sufficient degree of exactitude by means of Wanklyn's colorimetric method.

Before actually using the combustion-apparatus it is indispensable to heat the empty tube with the absorption-apparatus attached in a current of hydrogen until every trace of ammonia which stuck to the surface of the tube, the cork, &c., is expelled, and then to let it cool down in a slow current of hydrogen. It is also necessary to determine once for ever the amount of ammonia which the working quantity of soda-baryta used in each analysis gives up when burned with, say, a few milligrammes of sugar or mannite. This ammonia—which, with pure preparations, will not amount to more than 1 to 2 hundredths of a milligramme—must be deducted from the ammonia found in our analyses as a constant error.

In proceeding now to give what evidence we have to offer of the exactitude of our method, we should begin by reporting a number of blank experiments made with pure water, which, with us, means distilled Loch Katrine water freed from its ammonia by fractional re-distillation with a pinch of carbonate of soda. But we think it will suffice to say that, although in all cases the "organic ammonia found, instead of being = 0, amounted to something measurable by Nessler's reagent, we found it easy, by careful work, to bring down this quantity to one or two hundredths of a milligramme.† But let us now pass to our analyses:—

1. 12.9 m.grms. of hippuric acid, weighed out dry and burned with soda-baryta, gave a quantity of  $\text{NH}_3$ , of which one-tenth, when Nesslerised, was found in two experiments to amount to 0.12 m.grm. of ammonia. The formula demands 0.12.
2. 50 m.grms. of nitrate of potash, dissolved in 200 c.c. of pure water, alkalised with caustic soda until the distillate showed nothing with Nessler,—residue evaporated with 45 c.c. of aqueous sulphurous acid and a few drops of ferric chloride,—obtained, on combustion, 0.03 m.grm. ammonia ( $\text{NH}_3$ ) instead of 0.00.
3. A similar experiment, with nitrate of potash = 10 m.grms. of ammonia, and hippuric acid = 0.10 m.grm. ammonia, gave 0.18 m.grm. of ammonia—*i.e.*, 0.08 m.grm. too much. (A failure.)
4. Nitrate of potash = 5 m.grms. of ammonia, hippuric acid = 0.10. Found 0.15 m.grm. of ammonia. Excess found = 0.05 m.grm., which is rather more than can be tolerated.
- 5, 6, and 7. Experiments with artificial waters. *Modus operandi*: 650 c.c. of pure water distilled down to 500—the residue now absolutely free from ammonia—charged with known quantities of nitrogenous materials, and free and organic ammonia determined.

In Exp. 5 there were added known quantities of sal-ammoniac, sulphate of quinine, and nitrate of potash. Results:—

	Free $\text{NH}_3$ .	Organic $\text{NH}_3$ .	Nitric $\text{NH}_3$ .
By synthesis ..	0.10	0.100	0.017
By analysis ..	0.10	0.095	—

\* Why the baryta? Well, soda alone would probably do. We originally intended to effect the fusion in the tube itself, and added the baryta to moderate the action of the soda on the glass. And as we had a stock of the mixed reagent on hand we used it. It fuses at a remarkably low temperature, and, in an atmosphere of hydrogen does not act much even on copper.

† In the analyses given below this purely adventitious ammonia is not allowed for: we prefer giving the numbers as we found them.

In Exp. 6 the substances used were sal-ammoniac, nitre, and urea. Results:—

	Free NH <sub>3</sub> .	Organic NH <sub>3</sub> .	Nitric NH <sub>3</sub> .
By synthesis ..	0.05	0.140	0.17
By analysis ..	0.05	0.162	—

In Exp. 7 the substance used consisted of urine solids diffused throughout a large body of sulphate of potash. 1.0115 grms. of this mixture, when burned with soda-lime in the ordinary fashion, gave 0.0488 grm. platinum, = 8.41 m.grms. ammonia—i.e., 8.31 m.grms. ammonia per gramme. 28.1 m.grms. of these dilute urine solids were dissolved in half a litre of absolutely pure water, prepared as in Nos. 5 and 6, and the water analysed. "Free ammonia" in the several fractions of distillate (each = 50 c.c.) was found to be—

1st.	2nd.	3rd.	4th to 9th.	Total.
0.013	0.004	0.001	Nil.	0.018

"Organic ammonia," as found by combustion, amounted to 0.225: hence "total ammonia" = 0.243 m.grm. The above analysis demands 0.233 m.grm.

It is surprising to see the very slight extent to which the urea was decomposed in the course of such a protracted distillation with an immense quantity of water, and notwithstanding the presence of those other urine constituents which usually are supposed to deprive urea of its stability against water. No doubt part of the 0.018 of our "free" ammonia really did come out of ammonia salts: hence about 95 per cent of the urea survived the distillation.

It seemed to us interesting to see what would come of the application of Mr. Wanklyn's method to such an artificial water. We accordingly dissolved 29.5 m.grms. of dilute urine solids in 500 c.c. of absolutely ammonia-free water, and next distilled off 300 c.c. for the determination of the "free ammonia." In the remaining 200 c.c. the "albuminoid" was determined by means of alkaline permanganate, as prescribed by Mr. Wanklyn in his book. The results were—

Free ammonia, 0.021.

Albuminoid ammonia (in the several fractions of distillate)—

50 c.c. of Distillate.				
1st.	2nd.	3rd.	4th.	
0.042	0.0075	0.015	0.02	
In all .. .. .				0.085
A blank experiment with the reagent and pure water gave .. .. .				0.007
Albuminoid corrected .. .. .				0.078

Reducing to 28.1 m.grms. of dilute solids and combining with No. 7 we have—

Free NH <sub>3</sub> .	Albuminoid.
0.018	0.074

The total organic NH<sub>3</sub> (according to No. 7) is 0.225—i.e., above three times the albuminoid.

To be able to supply exact data as to the amount of time required for executing a nitrogen determination according to our method, we timed one of the analyses of artificial waters. We commenced work at 10.30 a.m. The "free" ammonia was determined and the residue ready for combustion by 1.30 p.m., and the combustion finished and the ammonia Nesslerised by 2.10: that is to say, the whole of the analysis was done in less than four hours, which compares very favourably with Dr. Frankland's process. With regard to the degree of exactitude attainable, the latter process no doubt is superior to ours in those cases in which the quantity of nitrogen present is large, as, for instance, in the analysis of sewage or positively foul waters; but these are precisely the cases where a relatively high degree of precision is uncalled for. Passing to the more important case of a water which is

not positively bad, we feel sure it will be admitted that our process, even in point of precision, is far ahead of Frankland's; besides, it enables one to *measure* quantities of ammonia which, if given as nitrogen gas, would be barely visible in a eudiometer.

After what we said in the introduction we need not specially state that we do not mean our process of nitrogen determination to supersede Mr. Wanklyn's albuminoid ammonia process. We should be sorry to see that process fall into abeyance, because, whatever may ultimately turn out to be its real value, no doubt it is a step in the right direction,—in that direction, in fact, in which the science of the subject will progress, if it is to advance at all.

Prof. Dittmar's Laboratory,  
Anderson's College, Glasgow.

## ON AMMONIUM VANADIATE PRECIPITATED FROM ALKALINE VANADIATES WITH AMMONIUM CHLORIDE.

By Dr. B. W. GERLAND.

THE precipitation of the alkaline vanadiates by ammonium chloride has been already applied by Sefström and Berzelius, and was recommended by von Hauer for the quantitative separation of vanadium from the alkalies, and since then adopted in all text-books. I also made use of this method for a quantity of potassium sodium vanadate containing several kilogrms. vanadic pentoxide, and obtained the ammonium salt, which, carefully washed, yielded a pentoxide that crystallised beautifully when solidifying from its molten state, but contained, nevertheless, a considerable amount of alkalies. As I could find no reference to this experience, I undertook the investigation, and obtained the following interesting results:—

(1.) Vanadic pentoxide was fluxed with 3 molecules potassic sodic carbonate, the solution of the flux poured into a boiling solution of ammonium chloride, filtered after cooling, and washed with ammonium chloride solution until the washings volatilised without leaving a residuum, then washed with weak alcohol until the reaction for chlorine had disappeared. The salt was then pressed and dried in the exsiccator. 1 grm. of this ammonium vanadate was submitted to analysis in the following manner:—The aqueous solution was precipitated with lead acetate, the filtrate treated with sulphuretted hydrogen, after separation of the precipitate evaporated to dryness, and heated for the volatilisation of the ammonium salt. The small residuum contained a little vanadium, and was therefore again treated in the same way. After the ammonium salts had been driven off the second time, the residuum was moistened with hydrochloric acid, heated to dull redness, and weighed. It consisted of potassium chloride with a trace of vanadic pentoxide. Weight, 0.0418 grm., or 4.8 per cent; containing chlorine (found), 1.92 per cent; calculated potassium, 2.11 per cent.

(2.) The ammonium vanadate of No. 1 was dissolved in water (accidentally in well water) under addition of ammonia, the solution poured into a concentrated boiling solution of ammonium chloride, and the precipitate treated as above. Found—

Lime .. .. .	0.28 per cent.
Potassium chloride ..	0.23 per cent.

(3.) Vanadium pentoxide was fluxed with 3 molecules sodium carbonate, and the ammonium salt prepared and purified as described under No. 1. It was, according to the analysis, free from sodium. The analyses of this and the following salts were carried out as in No. 1, with this modification: the filtrate from the lead vanadate was heated, ammonia and ammonium sulphide added, the boiling continued until the liquid was completely decolour-

ised, and then filtered without delay and interruption. Much time is saved by this method, and the advantage gained that the small amount of vanadium is almost entirely separated with the lead sulphide; only unweighable traces are left in solution.

(4.) Ammonium vanadate prepared with the detailed precautions from potassium ortho-vanadate.

1.4034 grms. yielded 0.0757 gm. potassium sulphate; this sulphate yielded 0.1027 gm. barium sulphate; calculated from the  $K_2SO_4$  0.1013 gm. barium sulphate.

The ammonium vanadate therefore contained 2.42 per cent potassium.

(5.) The ammonium vanadate of No. 4, re-crystallised from water. 0.5334 gm. yielded 0.0046 gm. potassium sulphate

The ammonium vanadate therefore contains 0.39 per cent potassium.

The ammonium vanadate of No. 4 dissolved in water, the solution poured into a concentrated boiling solution of ammonium chloride. 1.0705 gm. yielded 0.0069 gm. potassium sulphate.

The purified ammonium vanadate therefore contains 0.25 per cent potassium.

In all these experiments the ammonium vanadate was precipitated under the most favourable conditions. If, according to the directions generally given, the separation is effected by placing solid sal-ammoniac into the solution of the alkaline vanadate the amount of potassium increases considerably.

Ammonium vanadate, therefore, cannot be obtained free from potassium by precipitation with ammonium chloride if the solution contains potassium, whilst the presence of sodium salts does not interfere with the purity of the vanadate.

The obstinacy with which potassium is retained by vanadium compounds is remarkable. It is not limited to the ammonium vanadate separated from alkaline solutions, but also manifests itself with different compounds of other oxides of vanadium, whether they are formed in acid or alkaline liquors. Thus, according to my observations, the compounds  $V_2O_5$  and  $V_2O_4$  (vanadic sulphates, which I shall shortly describe),  $V_2O_5 \cdot H_2O$  and  $V_2O_4 \cdot 2H_2O$  (vanadylous sulphates), all formed in strongly acid solutions, enclose potassium, if present, and in the case of the insoluble vanadic sulphates it cannot be extracted by boiling with dilute hydrochloric or sulphuric acid.

Ammonium behaves to some extent similarly to potassium. As I have already mentioned (CHEMICAL NEWS, vol. xxxiv., p. 2), the bronze-like metavanadic acid retains a small amount of ammonium, which cannot be removed by treatment with acids. Several metallic salts of vanadic acid—for instance, copper ortho-vanadate—contain ammonium present in the liquor in which it is formed, and the latter cannot be removed by washing.

Macclesfield, July, 1877.

## REACTIONS BETWEEN SOLUBLE AND INSOLUBLE SALTS.

By WATSON SMITH, F.C.S.

I. WURTZ says of such reactions that they are characterised by a change of elements, which tend to establish themselves. Thus, if a sodium carbonate solution be boiled with one of barium sulphate a partial decomposition takes place, barium sulphate is partially converted into barium carbonate, insoluble like the sulphate, and in solution there is a certain quantity of sodium sulphate. This decomposition is the more complete the larger the proportion of sodium carbonate employed. Thus the influence of masses is considerable. Now when sodium sulphate is made to react upon barium carbonate by boiling a solution of the former with a quantity of the latter a partial double inter-

change also takes place. Even in the cold this interchange occurs to some extent, barium sulphate and sodium carbonate being formed.

II. I have recently found that between the alkaline oxalates and the earthy carbonates (and other insoluble metallic carbonates) a partial double decomposition occurs, insoluble earthy oxalate and soluble alkaline carbonate being formed.

As already known, on the other hand, alkaline carbonates on boiling decompose the earthy oxalates. I attempted a measurement of the extent of decomposing force put forth in the above cases, both in the cold and in boiling solutions, by taking equivalent weights of the salts, the same volume of water, allowing to stand during the same time, or when boiling for the same time, and washing with the same volume of water. The results were reckoned in terms of sodium carbonate as follows:—

Action of sodium oxalate on the earthy carbonates, viz., of—

				Cold.	Hot.
Calcium	..	..	..	19.83	22.90
Strontium	..	..	..	7.63	7.38
Barium	..	..	..	4.84	4.98
Lead	..	..	..	6.35	13.08

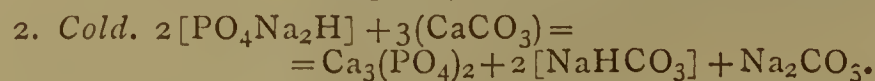
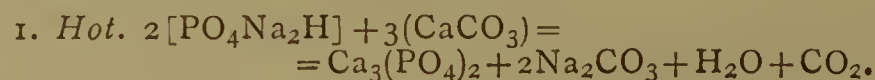
Per cents of  $Na_2CO_3$  formed of what would be if decomposition complete

Action of sodium carbonate on the oxalates of—

				Cold.	Hot.
Calcium	..	..	..	16.07	52.34
Strontium	..	..	..	57.24	79.96
Barium	..	..	..	73.20	87.96
Lead	..	..	..	81.54	90.61

Per cents of  $Na_2CO_3$  converted into oxalate of what would be if decomposition complete.

III. Recently a paper has appeared in the *Bull. de la Soc. Chim. de Paris*, xxvii., No. 11, p. 499, by Messrs. A. Frebault and A. Destrem, in which they testify to having found that neutral phosphate of sodium decomposes the insoluble carbonates under already mentioned circumstances. Thus sodium phosphate decomposes calcium carbonate, and the  $CO_2$  resulting unites with the soda set free to form sodium hydrogen carbonate, which decomposes on boiling into  $Na_2CO_3$  and  $CO_2$ . The decompositions they express in two equations:—



It was further found that all the insoluble carbonates are decomposed by sodium phosphate, the rule being verified in the case of the following carbonates:— $BaCO_3$ ,  $MgCO_3$ ,  $ZnCO_3$ ,  $MnCO_3$ . The fact appears to the authors of great importance in relation to the formation of the natural phosphates, and in the grouping of the elements in the analysis of mineral phosphatic waters. However, the authors have committed one rather serious blunder; they make the following assertion:—"Calcium phosphate cannot decompose sodium carbonate to form sodium phosphate and calcium carbonate, whilst sodium phosphate decomposes calcium carbonate, forming calcium phosphate and sodium carbonate." Now whether anything still earlier in contradiction of the above has been discovered I do not happen to know; but this I know, that in the early part of last year, or about the close of 1875, my friend, Mr. C. T. Cross, made some experiments in the laboratory of Zürich University on the action of boiling solutions of sodium carbonate on the precipitated phosphates of the alkaline earths, and found that decomposition did take place. On repeating the experiments I found that in the case of calcium phosphate (precipitated) not only does a boiling solution of sodium carbonate decompose it, but

that a cold concentrated solution, on standing for half a day, with frequent shaking, also decomposes it to some extent.

IV. The thought now occurred to me, "Sodium carbonate solution decomposing both calcium oxalate and calcium phosphate, is it possible that sodium oxalate will act upon calcium phosphate so as to bring about a mutual interchange of basic elements."

a. I boiled for two hours about equivalent weights of sodium oxalate and pure precipitated calcium phosphate together. The amount of water present was sufficient to form a tolerably concentrated solution of the sodium oxalate. On filtering and evaporating I was able to crystallise out sodium phosphate; the quantity formed was proportionately larger. The mutual decomposition, therefore, appears in this case to approach completeness.

b. Some pure calcium oxalate was now boiled with ordinary sodium phosphate for two hours, the phosphate being in excess. The whole was now filtered, and the precipitate washed well with hot water. The filtrate was evaporated to dryness, and ignited well. The ignited residue was treated with hydrochloric acid, when a lively effervescence occurred,  $\text{CO}_2$  escaping, proving the presence of dissolved sodium oxalate in the filtrate. The precipitate left on the filter was also dried and ignited thoroughly, and then treated with acetic acid, which dissolved a portion of the precipitate with effervescence. A rather small residue was left, and this was tested according to the usual methods for phosphoric acid, which was found abundantly present in the residue, proving it to consist doubtless of calcium phosphate.

The measurement of these reactions, or of the elective affinities under varying circumstances of mass, temperature, dilution, &c., would probably furnish interesting results, and this subject I have now in hand.

Technical Laboratory, Polytechnikum, Zürich.

## NOTICES OF BOOKS.

*The Laboratory Guide: a Manual of Practical Chemistry for Colleges and Schools, specially arranged for Agricultural Students.* By A. H. CHURCH, Professor of Chemistry in the Agricultural College, Cirencester. London: Van Voorst.

THIS work has now reached its fourth edition, and has been enlarged, and in many respects improved. In judging of its merits it is essential to bear in mind the author's object. He writes for students who are seeking to obtain a practical knowledge of chemistry as applied to agriculture, who can devote but a very limited amount of time to the subject, and who are still expected, at the end of their college career, to make a fairly accurate analysis of a soil or a superphosphate. Hence the omission of the rarer elements, and indeed of all which are not known to have a bearing upon plant-life, or to be useful as reagents, is here perfectly legitimate.

Like the former editions the present work consists of three parts: the first intended as a guide to chemical manipulation, and to give the student a practical acquaintance with the chief classes of facts with which he will have to deal; the second is devoted to qualitative analysis, with the preparation and use of the various reagents required; whilst the third treats of the quantitative analysis of soils, manures, and the produce of the farm. In all these sections, especially in the last, considerable additions have been made. Thus we find instructions for the analysis of beer, butter, cheese, cream, (woody) fibre, hay, leaves, milk, ash of plants, wines, &c. Milk, liable as it is to adulteration, can scarcely from this point of view come under the notice of the purely agricultural analyst,

since the fraudulent additions, as a rule, take place after it reaches the dealers in our towns. Mr. Church very rightly repudiates the lactometer and the creamometer, though he places some confidence in the indications obtained by means of the lactoscope. In his directions for taking the total solid matter in milk he does not fall into the error of recommending the addition of plaster or sand during the process of evaporation. A hint on the importance of thoroughly agitating a sample of milk so as to ensure perfect commixture before weighing or measuring off portions for analysis would have been useful. Whilst on this subject we cannot help pointing out that the influence of the race or breed of cows upon the quality of milk has scarcely been sufficiently examined. Mr. Wanklyn, indeed, shows that the prejudice in favour of the milk of the Alderney breed is not well founded; but we have met with no facts as to the supposed poverty of the milk of short-horns as compared with that of the old long-horned breed.

In the processes laid down for the analysis of manures we find little change as compared with the second edition. The methods are practicable, the descriptions are clear, and under any ordinary circumstances a student who follows the instructions here laid down will arrive at accurate results. Were every precaution that may be needed under unusual circumstances given in detail the book would acquire encyclopædic dimensions. For instance, in "bone-dust, bone-shavings, boiled bones, and bone-ash" the amount of tribasic phosphate of lime may doubtless be determined with sufficient accuracy by the method given by Mr. Church—i.e., by precipitation with ammonia, observing certain precautions here stated; but suppose the sample adulterated, as we have once observed, with granulated furnace-slugs, containing, of course, alumina and iron oxide soluble in hydrochloric acid, the process is no longer applicable. But an author can scarcely be expected to provide for such exceptional cases.

The arrangement of the combustion-tube in the determination of nitrogen is here illustrated by a figure, and the description is more complete than in the second edition.

The presence of vegetable ivory among turners', scale-cutters', and cutlers' refuse is mentioned as a new impurity, not always, however, to be regarded as an intentional fraud.

The instructions given for the analysis of apatites and coprolites are substantially the same as in earlier editions. When the latter, however, contain much carbonaceous matter the "fusion-method"—ignition of the dry, powdered sample with four times its weight of a fusion-mixture of 2 parts sodium carbonate to 1 part of potassium chlorate or nitrate—is recommended.

The chapter on superphosphates is also essentially unaltered. The "reduced phosphates" are directed to be determined by the bicarbonate of soda method. At the same time the author admits that the results are not as accurate as might be desired, and places on record his opinion that such "reduced" phosphates are by no means of equal value with such as are soluble. With this view we decidedly agree, and we know that several manure-makers of ample experience consider that if such "reduced" phosphates are classed with and valued as "insoluble" phosphate, substantial justice will be done to buyer and seller.

In the determination of phosphoric acid in soils, &c., by the molybdic acid method,—the only really safe procedure,—the molybdic precipitate is recommended to be dissolved in a minimum of *hot* dilute ammonia, which we think an improvement. For the molybdic acid solution, however, we prefer Sonnenschein's formula to the one given by the author. We are also of opinion that a better "magnesia mixture" may be made by adding chloride of ammonium to chloride of magnesium than in the usual manner with sulphate of magnesia.

In the determination of alkaline salts—e.g., in artificial manures—the magnesia present is directed to be precipi-

tated with baryta-water, the excess of baryta being afterwards removed by the addition of the carbonate of ammonia instead of as recommended in the earlier editions, at once precipitating with carbonate of ammonia.

As to the real value of the book, taken as a whole and fairly viewed with reference to the author's object, we do not imagine that there is much room for difference of opinion. We know that it is highly prized by chemists engaged in manure-works, and we are glad to learn that it is adopted by the Indian Government as a manual for agricultural students. It is also the recognised text-book in the Imperial Agricultural College of Japan.

*Chemical Handicraft: a Classified and Descriptive Catalogue of Chemical Apparatus.* By J. J. GRIFFIN, F.C.S. London: J. J. Griffin and Sons.

THIS book, as the Preface very truly declares, is something more than a mere price-current. It partakes in no small degree of the character of a treatise on chemical manipulation. The student, the professional analyst, and the philosopher engaged in original research will each be able to see here the instruments which they may require for any especial purpose. Many newly-designed or improved articles have been introduced in this edition, among which we may mention the requisites for the blow-pipe experiments described in Major Ross's "Pyrology," and which are supplied either separately or in complete sets. We are sorry to see that the lactometer and creamometer are still in sufficient demand to warrant their being figured and described in the pages before us.

In gas-burners and gas-furnaces great improvements have been effected. They can now be procured in a great variety of sizes and designs, and are suitable for all processes of ignition, combustion, fusion, or dry distillation, at temperatures ranging from redness to full whiteness. To be thus delivered from the charcoal-, coke-, or coal-furnace, with its cumbrous fuel, its dust, ashes, and fumes, is a boon which experimentalists will duly appreciate. The "gas crucible and muffle furnace" is an exceedingly useful piece of apparatus, and the "miniature blast gas furnaces," No. 1155, will often be found serviceable in analytical operations for ignitions requiring a higher temperature than can be readily procured with a gas-burner.

In graduated glass vessels for volumetric analysis—such as burettes, pipettes, measuring flasks, mixing jars, &c.—improvements have been made, some of which, however, such as the increased accuracy in graduation, cannot be shown by description or illustration. Among burettes, Mohr's, with its modifications, is becoming a more and more recognised instrument, whilst Gay-Lussac's and still more Binks's are falling into desuetude. The latter, indeed, is in many establishments now used only for rough, approximate estimations which have to be performed by workmen. We do not perceive in the catalogue any mention of the apparatus which have been devised for the technological analysis of furnace-gases, chamber-gases, &c.

Physical, as distinct from chemical, apparatus is—with few exceptions—relegated to a distinct catalogue, under the name of "*Scientific Handicraft*," part of which has already appeared, and the remainder is understood to be in progress. Hence microscopes, &c., no longer figure in the work before us.

No one can deny that the compilation of "*Chemical Handicraft*" represents a very great amount of thought, labour, and patience, and we trust that the useful enterprise of Messrs. Griffin will be appreciated by the profession.

*Researches on the Tetrachloride of Carbon, and its Use as an Anæsthetic.*—M. C. Morel.—The author having vainly attempted to use the tetrachloride as a cheap source of chloroform, prepared it pure, and used it as an anæsthetic. He considers it perfect, more energetic than chloroform, but more easily regulated.—*Comptes Rendus*.

## CORRESPONDENCE.

## THE COLLEGE OF PHYSICAL SCIENCE.

*To the Editor of the Chemical News.*

SIR,—As I believe that all your readers are concerned in the welfare of the Newcastle College of Physical Science I have no hesitation in submitting to you for publication the enclosed from the *Newcastle Daily Journal*.—I am, &c.,

FRED. GUTHRIE.

*"To the Editor of the Newcastle Daily Journal.*

"SIR,—A copy of your paper has been sent to me containing an account of the distribution of prizes at the Newcastle College of Physical Science, from which it might appear that everything in that institution is as it should be. Some months ago my friend, Prof. Herschel, did me the great honour of asking me to examine some of his pupils. To do so I visited the College. That I found the three candidates whom I examined thoroughly well taught appears from the result of the examination, and is what I expected from pupils of so able and zealous a teacher. I noticed that the 'Preparation' room and 'Physical Laboratory' are totally unfit for their purposes, so much so that on my return home I wrote to the managers, pointing out the deficiencies in language, which I meant to be frank and forcible, without being offensive. As I have not heard from the managers, even to the extent of acknowledging my letter, I conclude that it is not producing the desired effect. The matter is one of such vital importance to your city that I beg you to allow me to lay the letter, as far as I can reproduce it from notes and memory, before your citizens:—

"TO THE MANAGERS OF THE NEWCASTLE COLLEGE OF PHYSICAL SCIENCE.

"Gentlemen,—I regret that I shall not be able to avail myself of your polite invitation to be present at the distribution of prizes on the 15th, and this the more because I am thereby prevented from speaking to you personally on a matter which is of the very greatest importance to you and of the highest interest to me, namely, the accommodation and appliances in the above institution for teaching physics. I must say at once that I am making this representation without the knowledge of the professor of physics, and at the risk of causing him annoyance. The "preparation" room, which is shared between the professors of chemistry and physics, is a miserable hole. The "physical laboratory" which is on the basement, and paved with flags, is equally wretched. No cat with any self respect would consent to be swung in either. It must be almost impossible for any instrument of precision to be employed. Three-quarters of the professors' time must be wasted in making shift: in making bricks without straw. Time which, if employed as it should partly be in research, would bring honour to your city and your professors and students to your college. Is it fitting that in one of the centres of the industries which depend so completely on science, not so much is done for it as in many a boys' school? It is not fitting; but it is a reproach to the wealth, to the intelligence, and to the forethought of your citizens. If it is necessary that there should be in Newcastle a little scientific appendage to the University of Durham, be it so; but for pity's sake do not call it a college of physical science, and for your own sake let there be something better; something more in accord with the noble intellectual traditions of Newcastle.—Your obedient servant,

"FREDERICK GUTHRIE."

"If this language is strong, it is, sir, on that account all the more appropriate. Nothing can express the pain and disappointment I felt in seeing, as well as the light would permit, in what dens Professor Herschel has to work.

Granted that he has succeeded marvellously well with his students; if he can hop as fast as others run, I for one would like to see him run. I do not speak of the chemical laboratory, only because I am not officially cognisant of its defects. I have been told that the publication of my letter to the managers would put the "Newcastle back up." What on earth does it matter whether the back is up or down so that the shoulder is to the wheel. Newcastle is justly renowned for the energy and enlightenment of her sons, and she is destined to become as pre-eminent in her educational power as she is in mining, manufactures, and commerce. Let not another generation go by stained by indifference to the most solid and noble of all wisdom—wisdom in nature.—I am, &c.,

"FREDERICK GUTHRIE.

"24, Stanley Crescent, Notting Hill,  
London, W., July 9, 1877."

## CONTRIBUTIONS ON CHEMICAL ANALYSIS.

*To the Editor of the Chemical News.*

SIR,—During the past six or eight months the readers of the CHEMICAL NEWS have been edified by an extensive series of notes on various points of chemical analysis contributed by a M. Sergius Kern, of the Obouchoff Steel Works.

As a rule chemists are greatly obliged to anyone having extensive experience of a process who will publish the exact details of his method of working for the benefit of others, and on this account we ought to feel much obliged to M. Kern. Unfortunately, however, that gentleman's contributions contain little that is novel, and that little is mostly incorrect.

One of the most striking peculiarities of M. Kern's contributions is that many of the factors used for calculation are totally wrong. As an example of M. Kern's calculations I may mention that on page 1 of vol. xxxv., the pyrophosphate of magnesium is stated to contain 13.51 per cent of phosphorus, instead of 27.92, which is the correct amount. The wideness of the discrepancy suggests at first that M. Kern has made the mistake of calculating  $Mg_2P_2O_7$  to P instead of to  $P_2$ , but in that case the percentage would have been 13.96 instead of 13.51, so that the error is not due to mere inadvertence. Again, on page 203 of the same volume, the same salt is stated to contain 36.04 per cent of magnesium instead of 21.82 per cent, which is the fact. As, however, the pyrophosphate really contains 36.04 of  $MgO$ , this mistake may possibly be a printer's error. But the same explanation will not apply to the wonderful error on page 67 of last volume, where  $Cr_2O_3$  is stated to contain 32.2 per cent of chromium—the true amount being 69.0 per cent! This erroneous factor is employed by M. Kern on page 107 (of the same volume) for all his calculations of the percentage of chromium in chrome ores, with the consequence that the reported percentage is in each case less than half of the truth! Without going further, it is evident that calculations are not M. Kern's strong point, and the fact that on page 17 of volume xxxv. he points out that the amount of carbon contained in 1 c.c. of a solution is one-eighth of the quantity contained in 8 c.c., appears to show that he imagines other people to be on a par with him.

In his last contribution M. Kern claims to have discovered a new metal. As Russian chemists have special facilities for examining platinum ores, and Bunsen has already pointed out the probability of the existence of a new metal in the very residue in which "Davyum" is said to have been discovered, I am far from asserting that M. Kern's claim has not a sound basis. On the other hand, any discovery by a chemist of the analytical antecedents of M. Kern requires confirmation, especially as almost the only special character of "Davyum" hitherto noticed is its low specific gravity. With the above specimens of M. Kern's calculations before us, it seems probable that the density may be open to correction. The reactions of

"Davyum" with acids and of its solutions with alkalies sulphuretted hydrogen, &c., present nothing exceptional, while its reaction with sulphocyanide is not shared only by iron (as M. Kern appears to suppose) but is common also to uranium and ruthenium, and probably other metals.

In conclusion, I may say that unless the coal-gas in Russia is exceptionally crude in its nature the proposal to purify it by means of a solution of nitrate of lead in soda (with a view to remove  $H_2S$  and  $SO_2$ , and thus lessen the action on platinum vessels of the products of its combustion) made by M. Kern on page 77 of the last volume, appears to be based on a misconception.—I am, &c.,

A. H. ALLEN.

Sheffield, July 13, 1877.

## BOILER INCRUSTATIONS.

*To the Editor of the Chemical News.*

SIR,—In the CHEMICAL NEWS (vol. xxxvi., p. 15) Mr. Edward Francis gives analyses of boiler incrustations. The three samples given are all instances in which calcium sulphate is the characteristic constituent. I fancy, however, in the majority of cases calcium carbonate will be found as the constituent predominating in boiler-deposits, although, of course, the nature of the deposit entirely depends upon that of the water used. The calcium carbonate being held in solution by an excess of free carbon dioxide is at once precipitated on the escape of this solvent, which is effected by heating the water. In the case of sulphate of lime, however, this can only be deposited in any quantity by supersaturation. The following are the results of analyses which I made some time ago of three samples of boiler incrustation in which calcium carbonate was the prominent constituent.

	I.	II.	III.
Calcium carbonate .. ..	71.75	75.90	80.5
Magnesium carbonate ..	7.41	7.81	4.6
Calcium sulphate .. ..	3.30	11.03	6.8
Silica .. .. .	10.16	2.61	8.1
Ferric oxide .. .. .	1.86	0.65	
Moisture, organic matter, &c.	5.52	2.00	
	100.00	100.00	100.0

Some time ago Mr. W. Johnson, of Edinburgh, kindly forwarded me the result of an analysis he had made of a sample of boiler deposit, in which silica curiously existed to the extent of 40.22 per cent. Below is his analysis:—

Silica .. .. .	40.22
Calcium carbonate .. ..	2.24
Calcium sulphate .. ..	41.02
Ferrous carbonate .. ..	5.71
Calcium phosphate .. ..	1.74
Magnesium carbonate ..	9.07
	100.00

It would be very interesting to know the source of the water which gave rise to this deposit. Was the silica in suspension, or in solution in the water?—I am, &c.,

WILLIAM H. WATSON.

Braystones, near Whitehaven,  
July 16, 1877.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

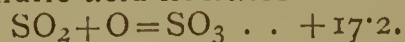
NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 25, June 18, 1877.

Notation of Berzelius.—M. Berthelot.—The author points out that M. Wurtz is in error in asserting that Berzelius wrote the oxides and the chlorides as do the modern

atomists. He wrote all the oxides in the same manner, KO, NaO, PbO, CaO, instead of dividing them into two groups,  $K_2O$  and CaO. He expressed all the chlorides also in one and the same manner.

**Certain Observations on the Mechanism of Chemical Reactions.**—M. Berthelot.—The author has observed some novel facts regarding the direct oxidation of haloid salts and of the sulphurous and arsenious acids. The haloid salts, if slightly moistened, absorb ozone at the common temperature—a fact well known as regards iodide of potassium, which yields iodate of potassa and a little free iodine. It is the same with the chloride of potassium which produces chlorate, and with the bromide which yields bromate, though both in small quantity. The absorption of ordinary oxygen by iodide of potassium disengages heat, say  $+44.1$  for  $IO_6K$ , and *a fortiori* the absorption of ozone. On the contrary, the conversion of chloride of potassium into chlorate by ordinary oxygen absorbs  $-11.0$ , and that of bromide into bromate  $-11.1$ . The superior energy residing in the ozone,  $+29.6$  for  $O_6$ , a quantity greater than  $11.0$ , is consumed by the direct synthesis of the chlorate and the bromate of potassa. In the case of sulphurous acid we find that the production of anhydrous sulphuric acid liberates—



But this reaction, by means of dry bodies, does not take place at common temperatures, and even if the two gases are kept in contact at  $100^\circ$  for forty-eight hours we have still no indication of combination. But if water is added the reaction is gradually effected, and the dissolved sulphurous acid is converted into sulphuric acid. This corresponds to a liberation of heat double that of the former— $SO_2$  dissolved  $+HO+O=SO_3HO$  dissolved  $+32.2$ . Even in the cold, when dry sulphur and oxygen (or rather ozone) combine under the influence of the electric effluve, a certain quantity of anhydrous sulphuric acid is also produced.

**Crystalline Form and the Optical Properties of the Proto-iodide of Mercury.**—M. Des Cloizeaux.—The crystals of this salt belong to the quadratic system, but might be mistaken for a clino-rhombic combination, in consequence of their very strong flattening on the two parallel faces of the fundamental square prism, and of the very unequal development of the surfaces of the octahedron  $a^1$ . The measurement of their angles yields numbers almost identical with those received for the proto-chloride of mercury (*calomel*), so that the two salts offer the most complete geometrical and optical isomorphism. It is worthy of remark that they are also geometrically isomorphous with the red biniodide of mercury.

**Electro-magnets with Iron Shields.**—M. Th. du Moncel.—This paper will, if possible, be inserted in full.

**New General Method for the Synthesis of Hydrocarbides, Acetons, &c.**—Second note by MM. Friedel and Crafts.—The reaction described in the authors' former paper is also produced when derivatives of the alcohols of the aromatic series are substituted for those of the fatty series. The chloride of benzyl readily reacts upon benzol in presence of chloride of aluminium, yielding benzyl-phenyl.

**Reducing Action of Phosphorus upon Sulphate of Copper.**—M. Sidot.—The author has allowed sticks of phosphorus to lie for some months in a cold saturated solution of sulphate of copper, and has obtained a series of copper tubes, the outer surface of which was covered with fine octahedral crystals of the metal. In this reaction the water is decomposed, metallic copper and phosphide of copper are formed, whilst sulphuric and phosphoric acids remain in the liquid.

**Crystalline Carbonate of Lead formed upon Objects found at Pompeii.**—M. S. de Luca.—Brilliant, well-defined crystals of carbonate of lead are found among the opaque amorphous variety. Their formation is not clearly accounted for.

**Observations on certain Xanthates: Separation of Cobalt and Nickel.**—Dr. T. L. Phipson.—Already inserted.

## MISCELLANEOUS.

**Award of the Lavoisier Medal.**—The Lavoisier Medal of the Société d'Encouragement pour l'Industrie Nationale has just been given to an Englishman, Mr. Walter Weldon, F.R.S.E. In presenting it M. Dumas congratulated Mr. Weldon upon having cheapened every sheet of paper and every yard of calico made in the world; and at the meeting at which the presentation took place Prof. Lamy stated that whereas at the date of the introduction of Mr. Weldon's invention, seven or eight years ago, the total bleaching-powder made in the world was only about 55,000 tons per annum—it is now over 150,000 tons per annum; and that of this vast quantity fully 90 per cent is made by the Weldon process. The Lavoisier Medal had been awarded only once before, namely, in 1870, to M. Henri Sainte-Claire Deville. The only other recipients of this Society's "Great Medal," which bears different effigies according to the class of service for which it is given, are Ferdinand de Lesseps, Boussingault, Jaques Siegfried, Henri Giffard, and Sir Charles Wheatstone.

## NOTES AND QUERIES.

**Water Analysis.**—I have frequently found on testing samples of water for the presence of metals that the ammonium sulphide hydrate produces a colouration when no metal is present, and which disappears on boiling. Will any of the readers of the CHEMICAL NEWS kindly explain the cause of the reaction?—R. L. HAWKINS, Hastings.

## THE QUARTERLY JOURNAL OF SCIENCE.

Edited by WILLIAM CROOKES, F.R.S., &c

Now ready No. LV., July, 1877, price 5s.

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Review of Dr. Carpenter's work on "Mesmerism, Spiritualism, &c." By Alfred Russel Wallace.

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## BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

The Office of Assistant General Secretary will shortly be vacant. Particulars of the new appointment and duties may be obtained on application at the Office of the Association, 22, Albemarle Street, London, W. Candidates are requested to send in their names to the General Secretaries, 22, Albemarle Street, with any attestation of their qualifications they may think desirable, on or before the 28th instant.

## BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, 22, Albemarle Street, W.

—The NEXT ANNUAL GENERAL MEETING of the Association will be held at PLYMOUTH, commencing on WEDNESDAY, August 15.

*President-Elect.*

Prof. ALLEN THOMSON, M.D., LL.D., F.R.S., F.R.S.E.

**NOTICE to CONTRIBUTORS of MEMOIRS.**—Authors are reminded that, under an arrangement dating from 1871, the acceptance of Memoirs, and the days on which they are to be read, are now, as far as possible, determined by Organising Committees for the several Sections before the beginning of the Meeting. It has therefore become necessary, in order to give an opportunity to the Committees of doing justice to the several Communications, that each Author should prepare an Abstract of his Memoir, of a length suitable for insertion in the published Transactions of the Association, and that he should send it, together with the original Memoir, by book-post, on or before August 1, addressed thus:—"General Secretaries, British Association, 22, Albemarle Street, London, W. For Section ....." If it should be inconvenient to the Author that his Paper should be read on any particular day, he is requested to send information thereof to the Secretaries in a separate note.

G. GRIFFITH, M.A.,  
Assistant-General Secretary, Harrow.

# THE CHEMICAL NEWS.

VOL. XXXVI. No. 922.

## ON REPULSION RESULTING FROM RADIATION.—PART IV.\*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 26.)

188. THE past summer and autumn have been very unfavourable for spectrum researches of this character. My first accurate experiments with the above-described apparatus were tried on July 26, and between that date and the middle September the apparatus was kept in good adjustment, so that use could be made of the comparatively few occasions when the sun was sufficiently clear. I find that, owing probably to a variation in the aqueous vapour in the atmosphere or to slight haze, the observations of one day are not readily compared with those of another. Isolated experiments on one part of the spectrum are therefore of slight value, and my endeavour has been to embrace as wide an extent of spectrum each morning as I was able. A cloudless sky is not always the clearest. The best results seem to be obtained when there is a moderate amount of wind, and great white clouds are floating about. The method of observation was as follows:—Having adjusted the scale so that the index ray of light pointed to zero, and having brought the particular part of the spectrum I wished to examine opposite the aperture in the screen, I opened the shutter and watched the progress of the luminous index until it reached its furthest point, when the shutter was closed. As the scale was divided into millimetres, the number of these traversed by the index was taken as the value of the part of the spectrum which shone on the pith. The piece of pith was 13 millims. square; consequently each number so obtained must be considered the average of a portion of the spectrum 13 millims. long.

189. I give below the actual results as they were obtained.

Date.	Portion of Spectrum thrown on to pith.†	Deflection of index ray of light. millims.	Observations.
July 26.	C	25	
"	D	19	
"	E	12	
"	b	8	
"	F	5	
"	between F and G‡	2	
29.	C	61	
"	D	34	
"	b	12	
"	F	9	
Aug. 4.	A	23	} Sky hazy, and light varying very much.
"	B	24	
"	C	35	
"	between C and D	27	
"	D	15	
"	b	10	

\* A Paper communicated to the Royal Society, February 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

† The lines were caused to fall on the exact centre of the pith. Consequently the action is caused by the portion of the spectrum 6½ millims. on each side of the portion here designated.

‡ The exact position of the central line falling on the pith was in this and similar cases carefully taken and marked on a diagram (see fig. 14).

Date.	Portion of Spectrum thrown on to pith.†	Deflection of index ray of light. millims.	Observations.
5.	between B and C	40	} The sun was very bright and powerful. All the observations were taken between 12 noon and 1 p.m.
"	D	29	
"	between D and E	24	
"	b	17	
"	F	10	
"	between F and G	6	
"	G	3	
"	H <sub>r</sub>	2	
13.	ultra-red	147	
"	"	121	
"	B	105	} Sun very bright. No clouds.
"	between C and D	75	
"	"	65	
16.	between A and B	96	
"	D	80	
"	between D and E	57	
"	b	33	
"	F	25	
"	between F and G	16	
"	"	12	
"	G	5	} Sun very bright, but small hazy clouds floating about.
17.	just below A	90	
"	C	65	
"	just above C	64	
"	D	63	
"	b	48, 42	
"	F	35	
"	between F and G	17	
"	G	11	
"	H	9	
31.	just below A	205	} White clouds in patches. Sun occasionally obscured. Could not work after noon.
"	C	155	
"	between D and E	110	
"	"	85	
"	E	67	
"	F	40	
"	between F and G	13	
Sept. 1.	ultra-red	35	
"	"	133	
"	"	170	
"	"	190	} Sun very bright, but large white clouds floating about. Observations taken during clear intervals.
"	"	127	
"	A	113	
"	B	102	
"	between C and D	79	
"	"	77, 75	
"	between D and E	59	
"	b	34	
"	F	23	
"	between F and G	14	
"	"	13	} Sun quite bright up to 12.30 p.m., then the sky became rather hazy.
"	"	12	
"	H	9	
10.	ultra-red	21	
"	"	100	
"	"	169	
"	"	215	
"	C	149	
"	E	82	
"	F	29	
16.	E	88	} Perfectly clear sky.
"	F	47	
"	G	18	
"	H	13	
"	ultra-violet	11	

190. In Fig. 14, which is reduced to half the linear scale, I have attempted to show the above results graphically. The horizontal band, crossed by vertical lines, at the lower part of the figure represents the solar spectrum. The vertical lines to which letters are attached are the



and at common temperatures, and I may state in this connection that auric sulphide is also soluble in this salt; platinic sulphide appears scarcely so, even in a hot solution of it, though sulphur is detectable in this solution afterwards by the nitro-prussic test.

I further find that argentic sulphide is not, as heretofore supposed, unattacked by mercury, but is decomposed, though very slowly by it, mercuric sulphide resulting, attended by amalgamation of the silver thus liberated. Auric sulphide is also very slowly decomposed in the same way; plumbic sulphide, however (as galena), is not.

It will be seen, therefore, that these sulphides in their deportment with mercury behave exactly as we should expect from the electrolytic results I have given in respect to them in my paper on the "Electro-motive Power of Gold and Platina in Sulphides,"\* both silver and gold being there stated to be negative to mercury in sulphide of sodium, and lead positive thereto. Indeed I may state that it was the knowledge of the electrolytic behaviour of the metals above named which induced me to try for the decomposition of argentic and auric sulphide by mercury.

In this connection I would further inform you that this sulphide (argentic) appears decomposed by chloride of copper alone, although it is stated not to be affected by this salt, except in the presence of an alkaline chloride. Theoretically, indeed, it should be decomposed by this cupric salt unaided, as sulphur has a greater affinity for copper† than it has for silver, and chlorine has a greater affinity for silver than for copper. There is no doubt, however, that the forming of this chloride of silver stops the action at a point at which we cannot readily distinguish that any action has taken place.

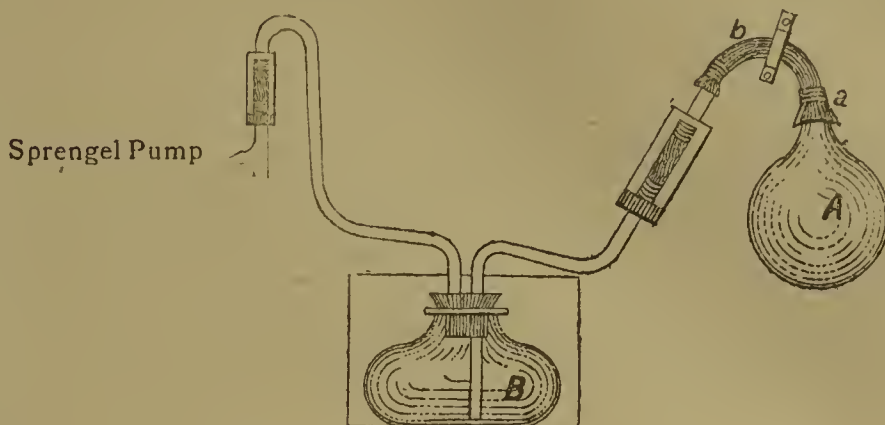
## ON THE ESTIMATION OF THE GASES DISSOLVED IN WATER.

By J. W. THOMAS.

THE method generally used for determining the quantity of the gases dissolved in water is a modification of Bunsen's, which is too well known to require much description. After the air in the connecting tube, dipping under the surface of mercury, has been removed by converting a portion of the water in the intermediate bulb into steam, the clamp of the flask is opened, and by the application of heat the gases are given off. A no inconsiderable portion of water passes down the connections, and in many instances, unless the greatest caution is exercised, the water in the connections and the gases evolved from the water in the flask rush over suddenly, and not unfrequently fill the collecting tube in the mercury trough to overflowing. In any case, however, it is impossible to collect the gases without a very appreciable quantity of water coming over with them, and this is cooled by passing through the mercury. If the quantity of gas is small it often happens that  $\text{CO}_2$  can scarcely be detected. About eighteen months ago I examined some chalybeate waters and estimated the dissolved gas, but was surprised to find so small a quantity of  $\text{CO}_2$ . On subjecting the water in the collecting tube to the expanding influence of a long column of mercury in a gas apparatus a very appreciable volume of gas was obtained. This loss of gases through the presence of water in the tubes in which they are collected has been verified on numerous occasions during the carrying out of some recent experiments.

The method which I used for collecting the gases from the waters referred to was by the aid of the Sprengel pump, using a large bulb on the Sprengel connecting tube,

and a calcic chloride tube to dry the gases before they passed over. I have since found that there is very little necessity for using a drying tube, and the apparatus I now employ is simply that shown in the sketch.



The flask A may be of the usual form, and holds  $\frac{1}{4}$  litre at  $15^\circ \text{C}$ . at the point *a*, where the caoutchouc tube *b* is wired on. The flask should naturally be filled at the well or source from whence the water is taken, and the gases estimated as soon as possible. The caoutchouc tube joined to the flask A should have very, thick walls, and is connected before the flask is filled with water, after which the tube is tightly pressed from the mouth of the flask A outwards, so as to remove the excess of water, and then securely clamped; if the temperature of the water is very low, and it has to be taken to a distance, pack the flask in sawdust with a small lump of ice at the bottom. The flask B holds about 150 c.c., and is of the form shown; the oil vessel of a "needle lubricator" answers well. B is fitted with an india-rubber stopper, well tapered, and pierced with two holes, through which passes a long tube in B, reaching within one-half inch of the bottom and forming the connection for the flask A, and the other tube simply passing through the stopper and forming the connection with the Sprengel. B is immersed in a beaker of water below the stopper.

After a vacuum has been formed, which will take about twenty-five minutes with a good pump, the clamp on A is quickly opened. If the vacuum remains but little impaired, owing to the gases dissolved being small in amount, shut off the pump, and by the application of heat drive off some of the water in the flask A until the end of the long tube in B is just covered with it; then start the pump, and the gases will be brought over remarkably free from water. If the quantity of gas present is large, exhaust some of it before applying heat to A, until the pellets of Hg in the Sprengel fall through some distance; then apply heat, working the pump slowly until the water in B covers the end of the tube; the vacuum should not be very complete until this is effected. After a little practice it is surprising how free from water the gases can be obtained, but if care is not taken it is better to introduce a  $\text{CaCl}_2$  tube between the flask B and the Sprengel. The beaker under B can be heated at the close of the operation in order to remove any traces of gas re-dissolved in the water which B contains, first removing the *collecting* tube and replacing by another in case any water should get over. I have tried the experiment three times, but in no instance did I obtain 0.2 c.c. of gas.

Little need be said regarding the subsequent treatment of the gases—they may be collected in a graduated tube of known volume and analysed by absorbing with liquid reagents, keeping the tube well agitated for five minutes during each operation; removing the liquid reagents by a plug of moist cotton-wool on the end of a wire, and letting the tube stand for twenty minutes in order to measure the volume; or, what is a more expeditious method, if a gas apparatus is at hand, measure and analyse a small portion of the gas first, and if the result is satisfactory measure the remainder; then the sum of the two portions multiplied by 4 will give the total dissolved gases per litre.

\* *Trans. N.Z. Inst.*, vol. iv., art. lii.

† *Ibid.*

REPORT  
ON THE METHODS EMPLOYED IN THE  
ESTIMATION OF POTASH AND PHOSPHORIC  
ACID IN COMMERCIAL PRODUCTS,  
AND ON THE  
MODE OF STATING THE RESULTS.\*

(Continued from p. 18.)

ONE very considerable advantage attaches in practice to Tatlock's method which is not shared by the others. In consequence of employing an aqueous liquid at first, any sulphates present can readily be washed out, and therefore there is no occasion to separate any moderate amount beforehand.

The influence of sulphates is well shown by the following results by Tatlock's method:—

TABLE VIII.

82 Per Cent KCl + 18 Per Cent Na<sub>2</sub>SO<sub>4</sub>.

Expt.	=KCl.	=KCl found per 100 parts taken.
64.	0.697	100.13
65.	0.697	100.25

} P.

TABLE IX.

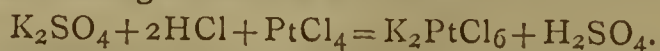
K<sub>2</sub>SO<sub>4</sub> with sufficient NaCl (0.5 grm.) to ensure the reaction  $K_2SO_4 + 2NaCl + PtCl_4 = K_2PtCl_6 + Na_2SO_4$ .

Expt.	=K <sub>2</sub> SO <sub>4</sub> .	=K <sub>2</sub> SO <sub>4</sub> found per 100 parts taken.
66.	0.70163	99.51
67.	0.70009	99.67
68.	0.70226	99.57
†69.	0.70255	99.78
70.	0.70087	99.80

} W.

} W.

The next experiments were made to ascertain the effect of employing hydrochloric acid instead of chloride of sodium according to the reaction—



In Experiments 71, 72, 73, 2 c.c. of hydrochloric acid were employed; in Experiments 74, 75, 2½ c.c. were used. The acid in each case had a density of 1.11.

TABLE X.

Expt.	K <sub>2</sub> SO <sub>4</sub> taken.	K <sub>2</sub> SO <sub>4</sub> found per 100 parts taken.
71.	0.70419	99.66
72.	0.70173	99.11
73.	0.70427	99.23
74.	0.70132	99.71
75.	0.70141	99.72

} W.

} W.

In the first three experiments the quantity of HCl appears to have been insufficient to effect complete conversion, but in the latter experiments the reaction seems to have been more perfect.

The following experiments were made in illustration of the use of Tatlock's process in the analysis of a German muriate, which was represented by a mixture containing 85 per cent KCl, 10 per cent MgSO<sub>4</sub> (anhydrous), and 5 per cent NaCl:—

TABLE XI.

Expt.	KCl taken.	KCl found per 100 parts taken.
76.	0.5949	99.999
77.	0.5947	99.910
78.	0.5951	100.120

} W.

\* Report of a Committee of Section B., British Association, consisting of E. C. C. Stanford, James Dewar, Alfred E. Fletcher, E. W. Parnell, T. R. Ogilvie, and Alfred H. Allen (Secretary). Drawn up by Alfred H. Allen.

† The precipitate obtained in this experiment, after drying at 130° C., gave 99.72 per cent of K<sub>2</sub>SO<sub>4</sub> per 100 parts taken.

A mixture containing 50 per cent KCl, 25 per cent NaCl, and 25 per cent MgSO<sub>4</sub>, was found by Mr. Galbraith to contain 99.83 per cent of KCl for 100 introduced, equal to 49.915 per cent in the actual sample.

In many of the experiments detailed it must be remembered that the actual departure from the truth is only a fraction of what it appears to be on calculation to 100 parts. Thus, in the above tables, the results are compared with 100 parts of the potassium salt taken, whereas in practice the results would be stated on 100 parts of the sample. Hence, in a mixture of equal parts of the chlorides of potassium and sodium, to obtain 100.5 parts of KCl instead of 100, would be expressed in practice by stating the sample to contain 50.25 of KCl and 49.75 of NaCl, thus reducing the actual error to half what it appears to be in some of the tables. This view finds expression in Table V.

The next experiments were made by Tatlock's method on pure nitrate of potassium, to which was added enough chloride of sodium (0.42 grm.) for the reaction—

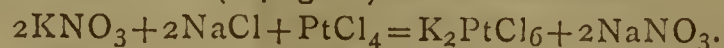


TABLE XII.

Expt.	Weight of Solution.	=KNO <sub>3</sub> .	Weight of Precipitate.	=KNO <sub>3</sub> found.	=KNO <sub>3</sub> Per cent.
81.	7.7090	0.70082	1.6868	0.69879	99.72
82.	7.7330	0.70300	1.6944	0.70212	99.87
83.	7.7325	0.70296	1.6953	0.70249	99.93

} W.

It appears, therefore, that Tatlock's process is applicable to the analysis of sulphates or nitrates, provided that there is sufficient chloride present for the formation of chloro-platinate of potassium. If not, it must be added in the form of sodium chloride, or in the case of sulphates hydrochloric acid may be used. When much sulphate is present the quantity of platinum solution used for washing the precipitate must be somewhat increased, or the results will be too high, owing to the insolubility of the sulphates in alcohol. Magnesium appears to cause no difficulty, the result 99.999 having been obtained in its presence.

When it is remembered that none of the foregoing experiments were made on a larger quantity than 0.7 of a grm. (about 10 grains), it will be seen that the determination of potassium as chloro-platinate is, when due care is taken, as accurate as the estimation of most elements, and when heavy metals are present quite as easily effected.

In practice it is rarely required to determine potassium very accurately in the presence of large proportions of foreign metals, but in the accurate assay of the better class products is becoming daily more important. If the proportion of sodium salts present in a sample exceeds 3 per cent the product is unfit for certain purposes, and as the determination of the sodium is strictly dependent on that of the potassium, any error in the latter is reproduced.

Although the results obtained by Tatlock's method show a decided loss when a very large proportion of chloride of sodium is present, this error nearly disappears with smaller amounts, and as the method is available in the presence of sulphates, nitrates, and magnesium, and is very readily conducted, it seems the best suited for the general assay of commercial potassium salts.

From a general consideration of the foregoing researches on the determination of potassium as chloro-platinate it appears that:—

(1.) Potassium in the form of pure chloride can be determined with great accuracy by precipitation as chloro-platinate. If a large excess of platinum solution be employed, and alcohol only used for washing the precipitate, the results have a tendency to exceed the truth. By avoiding the use of a large excess of platinum solution more accurate results are obtained. If a small volume of platinum solution be employed in the first instance for washing the precipitate (as recommended by Tatlock), and the washing then completed with alcohol in the usual way, the results are very accurate. Potassium chloro-platinate appears to be practically insoluble in a concentrated solution of platinic chloride.

(2.) In presence of a considerable proportion of chloride of sodium, washing the precipitate with alcohol alone tends to give results in excess of the truth. If the precipitate be first treated with platinum solution the results are somewhat low, apparently owing to the solubility of the precipitate in solution of sodium chloro-platinate: the error increases with the amount of sodium, but is never very large, and a correction may be applied if desired.

(3.) If Tatlock's method be employed there is no occasion to separate any sulphates, nitrates, or magnesium, but if the amount of chloride present is insufficient for the existence of all the potassium as chloride of potassium, the deficiency must be supplied by the addition of chloride of sodium or hydrochloric acid. The results obtained are in many cases very accurate, but have a tendency to be somewhat below the truth.

(4.) There is practically no advantage in drying chloro-platinate of potassium at  $130^{\circ}\text{C}$ . rather than at  $100^{\circ}\text{C}$ .; the loss at the higher temperature was found to exceed 0.07 per cent of the weight of the precipitate, but is probably governed by the conditions of precipitation.

(5.) The Committee is of opinion that a preliminary washing of the precipitate of chloro-platinate of potassium with a solution of platinic chloride is a valuable modification of the usual process. As the method so modified is capable of direct application to the commercial salts of potassium, and does not necessitate the removal of sulphates, nitrates, or magnesium, the Committee considers that it deserves to be generally applied to the determination of potassium in commercial products containing it.

So far the Committee has not thought it necessary to make any experiments on other methods of determining potassium than that in which it is converted into chloro-platinate.

(To be continued.)

## RUSSIAN SCIENTIFIC NEWS.

At a recent meeting of the Russian Physical Society M. Gesechus made some remarks on the elasticity of metallic palladium. Preliminary experiments showed the coefficient of elasticity to be 16,000 (platinum = 17,000). Hydrogenated palladium ( $\text{Pd}_2\text{H}$ ) has a rather lower coefficient = 14,400; this number remained the same even after three or four days, when a certain quantity of hydrogen was liberated. The diminution of the palladium wire could be observed for more than ten days.

M. Tchicaleff has executed during last winter interesting experiments on the intensity of the electric light in the open air. Magneto-electric machines of Altenec were used. The eye could not detect much difference in the lights of two machines—one equal two 10,000 candles, the second 4000 candles—notwithstanding that in the first case a refractor was used and in the second a reflector. During these experiments the advantage of carbon candles covered with galvanic copper was again proved; ordinary carbons burned for a length of 0.07 metre, while the carbons covered with copper burned for a length of 0.01 metre.

M. Grabowsky, of Kazan, has made some experiments with soap manufactured in Russia, and obtained the following results:—

1. Soap prepared from oleic acid contains less water than soap manufactured from solid fats (stearic acid).
2. With the decrease of the melting-point of the acids used in soap manufacture the dissolving power increases.
3. In soaps prepared from solid fat acids more than a third by weight is lost without any use when the soap is used for washing purposes.

At the same time the author proposes to use solid fat acids for the manufacture of candles, and the oleic acid for the preparation of soap; the resulting soap is easily soluble in water.

A peculiar hypothesis has been proposed by Professor D. J. Mendeleeff on the formation of naphtha in nature. In sandstones, where a great quantity of mineral oil is often found, there is no presence of organic deposits or of great quantities of coal or lignite. The author thinks that in all cases it is difficult to suppose that the formation of naphtha is due to the destruction of organic matter. M. Mendeleeff explains the formation of naphtha by certain reactions of mineral substances, viz., metallic carburets. In the interior of the earth abundant quantities of metallic carburets are supposed to exist, which, by the action of water under high pressure and temperature, give metallic oxides and primary hydrocarbons ( $\text{C}_n\text{H}_{2n+2}$ ). The hydrocarbons volatilise and condense in the superincumbent sandstones, which are spongy enough to condense great quantities of the mineral oil. Numerous experiments have been commenced by the Professor, which, when finished, will have a high interest for the chemist and geologist.

SERGIUS KERN.

Obouchoff Steel Works, St. Petersburg.

## PROCEEDINGS OF SOCIETIES.

DEUTSCHE CHEMISCHE GESELLSCHAFT,  
BERLIN.

July 9th, 1877.

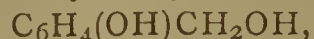
Professor C. LIEBERMANN, Vice-President, in the Chair.

DR. F. TIEMANN and P. KOPPE exhibited and described an "Apparatus for the Determination of Free Oxygen in Water," being essentially a simplification of Schützenberger's method. It consists of a flask from which the air can be expelled by a stream of hydrogen, connected with two burettes. One contains a solution of indigo and the other a solution of hydrosulphite of soda. The strength of the latter solution is obtained by comparison with a normal solution of a cupric salt. After expulsion of the air from the flask, a given quantity of the indigo solution is admitted, and sufficient hydrosulphite of soda added to decolourise the solution. A measured quantity of the liquid containing free oxygen is then admitted. The blue colouration which ensues is then removed with the solution of hydrosulphite, the amount required corresponding to the amount of oxygen present. A moderate temperature is maintained during the operation. The process yields very accurate analytical results.

C. O. CECIL, describes a peculiar "Action of Taurin in the Organisms of Birds." It has already been noticed that taurin in the human and canine organisms changes into the corresponding uramido acid, while in the urine of rabbits it gives rise to hyposulphurous and sulphuric acids. The author finds, on the contrary, that in birds which have been fed on taurin, a notable increase in the amount of  $\text{H}_2\text{SO}_4$  takes place, unaccompanied, however, by uramido, hyposulphurous, or sulphurous acids. In order to explain the decomposition of the taurin urea was sought for, but in vain. A large increase in the amount of uric acid was, however, noticed, leading to the conclusion that the urea formed by the decomposition was changed in the organisms of birds into uric acid. This assumption was confirmed by feeding fowls on urea, observation showing that the urea was changed completely into uric acid during the passage through the organism.

The same author describes the "Preparation of Dichloroacetanilide," which he obtains from dichloroacetic acid and aniline by digestion with phosphoric anhydride, and from ethylic dichloroacetate by first changing it into the amide and then digesting with aniline.

H. HERZFELD, "*Derivatives of Paroxy-benz-aldehyd.*" Among these are paroxy-benzyl alcohol,—



obtained by reducing the aldehyd with sodium amalgam, hydro-paroxy-benzoin,  $\text{C}_{14}\text{H}_{14}\text{O}_4$ , obtained by dilution of the solution in the preceding preparation, and nitro-paroxy-benz-aldehyd, resulting from the action of  $\text{H}_2\text{SO}_4$  and  $\text{HNO}_3$ . The aldehyd unites with ammonia to form an oily unstable compound, containing 1 molecule of each constituent. It unites also with a molecule of aniline under separation of water and formation of a crystalline compound. Salicylic aldehyd forms an oily compound with ammonia analogous to that derived from paroxy-benz-aldehyd.

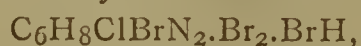
The following communications have been received from non-resident members:—

W. ZORN, "*Nitroso-silver.*" The yellow compound obtained by Meyer and regarded as possessing the formula  $\text{Ag}_2\text{O}, \text{N}_2\text{O}$  is found to be really nitroso-silver,  $\text{AgNO}$ , and forms nitroso derivatives with organic bodies.

A. CLASSEN, "*Separation of Iron from Nickel and Cobalt.*" The author states the conditions under which Wöhler's method (CHEMICAL NEWS, vol. xxxv., p. 141) succeeds best. If the iron is present as a ferric salt, and the solution is neutralised the addition of acetic acid and potassium oxalate, causes a complete precipitation of nickel and cobalt, and separation from iron.

M. LANDOLF proposes the use of "*Boron Fluoride as a Dehydrating Agent*" in the synthesis of organic compounds. From camphor he obtains a body containing no oxygen.

O. WALLACH and F. OPPENHEIM, "*On the Bases  $\text{C}_n\text{H}_{2n-3}\text{ClN}_2$* ." The authors examine first chloroxal-ethylin,  $\text{C}_6\text{H}_9\text{ClN}_2$ . Sodium acts on the base when dissolved in petroleum, causing the formation of an amorphous body, dioxal-ethylin,  $\text{C}_{12}\text{H}_{18}\text{N}_4$ . By the action of bromine on the solution of the base in chloroform two Br derivatives are formed, the formulæ of which an ingenious series of analyses shows to be—



and  $\text{C}_6\text{H}_8\text{ClBrN}_2 \cdot \text{Br}_2$ . Both are obtained as red crystals and are changed by water into bromo-chloroxal-ethylin,  $\text{C}_6\text{H}_8\text{ClBrN}_2$ , in which base the bromine is as firmly united as the chlorine.

I. REMSEN, "*Xylol-sulphamides.*" Some additional facts are added to the author's late investigations in this field. He announces further the intention of investigating the conditions which prevent a complete decomposition of the molecule when ternary derivatives of benzene are oxidised. Most of these have yielded hitherto the simplest oxidation products.

C. L. JACKSON and W. LOWERY, "*Para-bromo-benzyllic Compounds.*" Starting from para-bromo-benzyl bromide the authors have prepared para-bromo-benzyllic alcohol,  $\text{C}_6\text{H}_4\text{BrCH}_2\text{OH}$ , crystallising in colourless needles; para-bromo-benzyl acetate, a heavy oil; and para-bromo-benzyl cyanide, yellow crystals melting at  $46^\circ$  and possessing a strong odour. This cyanide is changed by treatment with  $\text{HCl}$  into para-brom-alpha-toluylic acid,  $\text{C}_6\text{H}_4\text{BrCH}_2\text{COOH}$ , white needles melting at  $114^\circ$ . Alcoholic ammonia changes para-bromo-benzyl bromide into tripara-bromo-benzylamin,  $(\text{C}_6\text{H}_4\text{BrCH}_2)_3\text{N}$ , melting at  $78^\circ$ . A sulpho-cyanate,  $\text{C}_6\text{H}_4\text{BrCH}_2\text{SCN}$ , was also obtained, melting at  $25^\circ$ , and very soluble in alcohol.

W. HAMMERSCHLAG, "*Bromine Derivatives of Anthracen.*" The tetra-bromanthracen of Graebe and Liebermann was changed by the action of Br vapours into tetra-bromanthracen tetra-bromide—colourless prisms—which, upon heating at  $230^\circ$ , yield penta-bromanthracen,  $\text{C}_{14}\text{H}_5\text{Br}_5$ . This forms a yellow powder, melting at  $212^\circ$ , and is changed by oxidising agents into tribromanthraquinon. The tetra-bromide forms upon treatment with alcoholic soda hexa-bromanthracen,  $\text{C}_{14}\text{H}_4\text{Br}_6$ , a yellow crystalline body, very insoluble in most solvents. This appears to be the limit of bromine substitution in anthracen.

Oxidation changes the compound quantitatively into tetra-bromanthraquinon, also an exceedingly insoluble body. Fusion with  $\text{HNaO}$  yields alizarin.

H. VOHL defends himself against a criticism of R. Fresenius on his statement "that water which contains alkaline bicarbonates and ferrous oxide in solution as well as ferric hydrate in a state of suspension does not admit of an evolution of  $\text{H}_2\text{S}$ ," by a comparison of well-known mineral springs.

B. W. GERLAND finds that the "*Separation of Vanadic Acid from the Alkalies by Means of Ammonium Vanadate*" is always imperfect when potassium is present, the precipitate invariably containing small portions of the latter. This is not the case with sodium, however. Other salts of vanadium, such as the sulphates, manifest this property of obstinately retaining small quantities of potash. Ammonium is likewise retained in the same way by certain vanadium salts.

A. LADENBURG and T. ENGELBRECHT, "*Derivatives of Thymol.*" Dinitro-thymol was changed into the ethyl ether; this was reduced into the corresponding diamido compound, and then changed by oxidation into oxythymoquinon. By treatment with  $\text{PCl}_5$  dinitro-thymol was changed into dinitro-chloro-cymene,  $\text{C}_{10}\text{H}_{11}\text{ClN}_2\text{O}_4$ , which, after reduction, yielded upon oxidation oxythymoquinon and chloroxythymoquinon,  $\text{C}_6\text{CH}_3\text{C}_3\text{H}_7\text{O}_2\text{OH} \cdot \text{Cl}$ . The latter yields, upon treatment with potash, dioxythymoquinon or thymozarin,  $\text{C}_{10}\text{H}_{12}\text{O}_4$ . This body is also obtained directly from oxythymoquinon by boiling with  $\text{HOK}$ . Theoretical considerations follow in support of the author's opinion that benzene contains two pairs of symmetrically united hydrogen atoms.

E. SCHUNCK and H. RÖMER find that "*Anthraflavon*," the condensation product of meta-oxy-benzoic acid, consists of anthraflavic acid, small quantities of a body dissolving with a purple-red colour in  $\text{H}_2\text{SO}_4$ , and a new compound, meta-benz-bioxy-anthraquinon, which melts at  $293^\circ$ , and yields a colouring matter on treatment with potash. No trace of iso-anthraflavic acid was detected.

J. PHILIPP, "*Action of Metallic Salts on Ultramarine.*" In order to settle the question as to whether other metals can be substituted for the sodium in ultramarine, and whether the commercial article is a definite chemical compound or a mixture of a distinct compound with other silicates, the author has first submitted ultramarine to the action of zinc sulphate. Experiment showed that the substitution of zinc for sodium was always confined within certain limits, about half the amount of the latter being replaced. The colour was scarcely altered, but the resulting compound was easily attacked by  $\text{KOH}$ , Zn being replaced by K, and a certain amount of  $\text{SiO}_2$  and  $\text{Al}_2\text{O}_3$  being removed. The reactions would seem to indicate that ultramarine contains a fixed compound not attacked by Zn, accompanied by silicates into which Zn can be introduced.  $\text{AgNO}_3$  causes, however, a complete replacement of Na by Ag in both of the constituents of ultramarine.

H. EKSTRAND obtains "*Trinitro-naphthol*,"—



by the action of  $\text{HNO}_3$  and  $\text{H}_2\text{SO}_4$  on  $\alpha$ -dinitro-naphthol (Manchester yellow). The compound and its salts crystallise finely, and possess more brilliant tinctorial properties than the dinitro-naphthol.

H. WEBER has prepared, among other "*Derivatives of Dioxy-naphthalen*," dibenzyl-, dibenzoyl-, and dimethyldioxy-naphthalen.

H. DIEHL, "*Cl and Br Derivatives of Anthracen.*" By treatment with  $\text{SbCl}_5$  octo-chlor-anthracen, penta-chlor-anthrachinon, and tetra-chlor-alizarin have been prepared. The corresponding Br derivatives have also been obtained.

H. ZETTER, "*Halogen Derivatives of Phenanthren.*" The octo-chloro- and the hepta-bromo-phenanthren were the most highly substituted compounds obtained.

G. RUOFF, "*Halogen Derivatives of Aromatic Bodies.*" Rosanilin hydrochlorate yields with  $\text{ICl}$ ,  $\text{CCl}_4$ , and  $\text{C}_2\text{Cl}_6$  only. These two bodies, as well as  $\text{C}_6\text{Cl}_6$ , result from

the action of  $\text{SbCl}_5$  on chrysen. Perbromo-phenol yields  $\text{C}_6\text{Br}_6$  on heating with  $\text{PBr}_5$ .

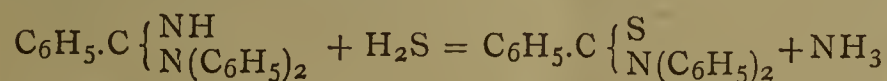
E. WAHL finds that by the "Action of Br on Hexan." The following bodies are obtained:— $\text{C}_6\text{Br}_6\text{H}_8$ ,  $\text{C}_6\text{Br}_8\text{H}_6$ ,  $\text{C}_6\text{Br}_8\text{H}_4$ ,  $\text{C}_6\text{Br}_8$ ,  $\text{C}_6\text{Br}_6$ .

H. MAY prepares "Carbo-diphenylimide," by boiling  $\text{HgO}$  with sulpho-carbanilide in alcoholic solution.

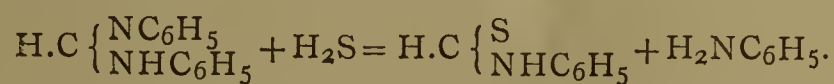
J. HANIMANN, "Reactions of Dimethyl-aniline." By heating the base with  $\text{CCl}_4$  or  $\text{CHCl}_3$  at high temperatures two strongly-characterised bases are formed, carbo-tetradimethyl-aniline,  $\text{C}[\text{C}_6\text{H}_4.\text{N}(\text{CH}_3)_2]_4$ , and formonyl-tridimethyl-aniline,  $\text{CH}[\text{C}_6\text{H}_4.\text{N}(\text{CH}_3)_2]_3$ .

A. BERNTHSEN has obtained "An Isomeric Benzenyl-diphenyl-amidine,"  $\text{C}_6\text{H}_5.\text{C}...(\text{NC}_6\text{H}_5)(\text{NHC}_6\text{H}_5)$ , by the action of benzo-nitrile on diphenylamine.

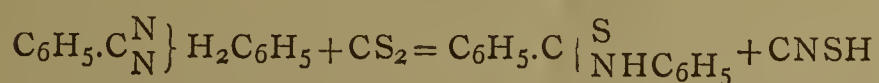
A. BERNTHSEN, "On the Thiamides of Monobasic Acids." The author describes two new reactions for the preparation of these bodies. The first is by the action of  $\text{H}_2\text{S}$  on amidines. Thus, benzenyl-iso-diphenyl-amidine yields benzo-diphenyl-thiamide,—



Methenyl-diphenyl-amidine gives the formo-thianilide of Hofmann (CHEM. NEWS, vol. xxxv., p. 240):—



The second reaction is with  $\text{CS}_2$  and amidines, thus benzenyl-phenyl-amidine yields benzo-thianilide—



C. BÖTTINGER obtains by the "Action of  $\text{H}_2\text{S}$  on Glyoxylic Acid" several new bodies, the formulæ of which cannot be satisfactorily established.

E. WROBLEVSKY has obtained "A New Xylidine," (1:3:5), melting at  $20^\circ$ , and boiling at  $220^\circ$ , by reducing the nitro-xylol prepared from iso-xylol.

E. v. GERICHTEN, "Cymene Derivatives." A chloro-cymene,  $\text{C}_6\text{H}_3\text{Cl}(\text{CH}_3)(\text{C}_3\text{H}_7)$ , was prepared by the action of  $\text{Cl}$  on camphor-cymene, and this changed into  $\alpha$ -chlorotoluic acid melting at  $194^\circ$ .

G. REHS obtains "Phenanthrol,"  $\text{C}_{14}\text{H}_{10}\text{O}$ , in the form of blue fluorescent laminæ by melting phenanthren-sulphonic acid with  $\text{KOH}$ . Various ethers are described.

H. SALKOWSKI and C. RUDOLPH, "Constitution of Dinitro-anisic Acid. The acid was changed by heating with water at different temperatures successively into dinitro-paroxy-benzoic acid and sodium  $\beta$ -dinitro-phenylate.

H. SALKOWSKI describes several "Double Salts of Two Organic Acids," obtained by bringing together equal quantities of benzoic and meta- or para-nitro-benzoic acids with the same base.

A. LADENBURG, "Derivatives of Ortho-toluydin." The author obtains methenyl-ditolyl-diamin, by heating formotoluide, and also by treating it with  $\text{PCl}_3$ .

A. BAEYER and H. CARO, "Synthesis of Indol from Aniline Derivatives." Indol was found to be formed by passing through heated tubes the vapours of monethyl-aniline, diethyl-aniline, methyl-ethyl-aniline, acetyl-ethyl-aniline, dimethyl-ortho-toluydin, and diethyl-ortho-toluydin. The last yields the best results. Diethyl-paratoluydin forms no indol. The indol is separated in the form of the picrate from the reaction products.

**Detection of Free Acids in the Gastric Juice.**—M. C. Richet.—Pure gastric juice contains very little but mineral or analogous acids. If left to itself it ferments, and the proportion of organic acids, analogous to the lactic, increases.—*Comptes Rendus*.

## NOTICES OF BOOKS.

*The Sizing of Cotton Goods, and the Causes and Prevention of Mildew.* By W. THOMSON, F.R.S.E. Manchester: Palmer and Howe. London: Simpkin and Marshall.

"The last and most important object of the majority of Lancashire manufacturers is to make grey cloths of specified dimensions, weight, and appearance with as little cotton as possible. The remainder of the weight, feel, and general appearance of the fabric to be made up with size." A rather startling confession this, and not easy to reconcile with a sentence which we find a few pages later that "sizing is a good thing, and may be carried on in a straightforward and honest manner, which is at present the case with the majority of Lancashire manufacturers."

The author disclaims any sympathy with adulteration, but thinks that size, beyond the proportion absolutely required to make the cloth withstand the wear and tear in the process of weaving, is valuable, because it "makes the fabric appear of better quality," and because the substitution of size for cotton "renders the resulting fabric much cheaper than would be that made entirely of pure cotton." The question, however, remains whether the degradation in quality is not out of all proportion greater than the reduction in price. We submit, further, that attempts to make any article of commerce look better than it really is are in their very essence cases of adulteration. The analogy drawn between calico and paper fails in several respects. We have no doubt that paper, like literature, may be at once pure and poor. It may also be sophisticated with substances which, though coming under the definition of vegetable pulp, are brittle and liable to clog the point of the pen. But calico is expected by the purchaser, whether he be an Englishman or a heathen Chinee to withstand a fair amount of wear and tear. With paper, now palimpsests are no longer manufactured, if it will bear writing upon once it has done its duty.

Leaving, however, the further consideration of these points to professed moralists, let us turn to the technological phase of the book before us. The author gives a full account of the machinery used in the process of sizing, illustrated with a figure of a modern power loom and of a tape-sizing machine. He next devotes a chapter to the apparatus and reagents employed in testing different ingredients used in size. Being ordinary laboratory-requisites they will be of course perfectly familiar to our readers. We are next introduced to the materials which the sizer throws into his cauldron. These the author divides into five classes. First come those required to give "adhesive properties" to the size, to wit, wheaten flour of different kinds, sago, maize, farina, rice, and dextrine or British gum. Next figure the materials used to give "weight and body" to the size and yarn, rendering the latter less like the baseless fabric of a vision. These are China clay, sulphates of baryta, lime, magnesia, and soda, soap-stone, silicate of soda, and chloride of barium. Among the oily or greasy matters used for softening the size and yarn are enumerated tallow of different kinds, palm oil, cocoa-nut oil, castor oil, olive and other oils, paraffin wax, and Japan wax. Then come a class of bodies which seem a repetition of the two former sections, since they also serve for softening and giving weight and body. Such are the chlorides of magnesium and calcium, glycerin, soap, and grape-sugar. Lastly, we find the remedies used to preserve the size from mildew and decomposition, namely, carbolic and cresylic acids, chloride of zinc and arsenical compounds. All these various bodies the author describes at considerable length, explaining their origin of manufacture, the methods of testing their quality, their advantages, drawbacks, &c. A great part of his remarks are of course to chemists "pipers' news," though to many manufacturers, merchants, and drapers they will doubtless be valuable. An interesting fact here mentioned is that Egyptian wheat-flour contains only 2.36 per cent of nitro

genous matter, or about one-fourth of the proportion here stated as found in English wheat-flour. Whether this great deficiency depends on the soil, the climate, the mode of cultivation, or the kind of the plant selected, does not appear.

Among the weighting ingredients figures sulphate of magnesia, in which, we are told, chloride of magnesium is an objectionable impurity. Yet, further on, we find the chloride of magnesium highly spoken of as strengthening the warp-threads to a greater extent than any other substance. It is, however, liable to produce mildew—the *bête noire* of the size-loving cotton manufacturer. What the author omits to mention is that chloride of magnesium, unless thoroughly washed out of textile goods before they are brought into use, is a direct attack on the health of the wearer by ensuring him the luxury of damp garments, bedding, &c.

The nature and origin of mildew is fully explained, and some of the cryptogamous plants to which it is traced are described and figured. As remedial, or rather preventive, agents arsenical salts are justly condemned, and the preference is evidently given to carbolic and cresylic acids.

The instructions given for the examination of a bale of cottons concerning which dispute has arisen, so as to ascertain whether the defects are due to the sizing or to negligence in packing, transport, and storage, are very judicious, and may be studied with advantage by experts who may be consulted on such questions.

Goods for shipment, the author holds, should be condemned if the inorganic constituents, and excess of moisture are large, the former above 13 and the latter above 1 per cent, and zinc chloride being absent or in very small proportion; if the goods contain chlorides of calcium or magnesium without a sufficient proportion of chloride of zinc or some other antiseptic; if the mineral ingredients are under 3 per cent and the farinaceous matters more than 15 per cent; with more than 0.5 per cent of excess of moisture and the absence of any powerful antiseptic. The normal moisture in cotton cloth is taken at 8 per cent.

We may think certain paragraphs of this work somewhat superfluous, and should in some instances prefer a different arrangement from that which the author has adopted. But we consider that he has thrown a valuable light on an important branch of manufacturing industry, and we trust that all concerned will remember and profit by his remark that the operation of sizing "as it now stands is one of the clumsiest, most unscientific, and least understood with which the manufacturer has to deal."

## CORRESPONDENCE.

### THE COLLEGE OF PHYSICAL SCIENCE.

*To the Editor of the Chemical News.*

SIR,—The letter communicated by Prof. Guthrie to the *Newcastle Daily Journal* of the 10th inst. regarding the College of Physical Science in Newcastle has now received a wider circulation and much increased publicity through the pages of your journal (vol. xxxvi., p. 32). As it is partly calculated to mislead your readers concerning some points of the efficiency and administration of the College, which are more or less directly touched upon in Professor Guthrie's emphatically-written letter, I trust that candour as regards the principal defects there noticed, and fairness as regards a tacit imputation of shirking their admission, which the publication of his letter (originally addressed to the managing body of the College) seems to convey, will ensure the insertion of a few lines in your journal in reply to such reproaches, and to remove any misapprehension that may have been produced of a necessity for their publication on that account having presented itself.

Prof. Guthrie's stirring remonstrance to the College authorities, although contained (as his letter shows) in a reply to a circular-invitation from them, and not appearing therefore to require a prompt acknowledgment, was yet considered with the deliberation and deference which it deserved, coming with the evidence of earnest good intention from such a high authority, and it was submitted to a committee already formed to devise improvements in the direction pointed out by Dr. Guthrie, and to report their recommendations to the College Council, by one of whom the thanks of the Committee were returned to Professor Guthrie for his communication. It was therefore without any assurance of their concurrence and consent that the unexpected reproductions of Professor Guthrie's letter in the columns of a Newcastle daily newspaper and in the pages of the *CHEMICAL NEWS* have since then appeared.

As regards the defects and deficiencies which are so strongly apostrophised in the letter, I need not occupy your space by referring to them further than to add that where Professor Guthrie's statements, which are in the main correct about the apartments which he visited, are not quite accurate in some details, allowance must be made for the short time that he had to make himself acquainted with the uses and capabilities of the parts of the College which were shown to him, more complete introduction to which, if the brief opportunity of his stay here had permitted, would perhaps have enabled him to modify somewhat the opinions which he expressed, and to take a less despairing view than he seems to have done of the aspects of physical science in the College of Science in Newcastle.—I am, &c.,

A. S. HERSCHEL.

College of Physical Science,  
Newcastle-on-Tyne, July 23, 1877.

### COMMERCIAL SULPHURIC ACID.

*To the Editor of the Chemical News.*

SIR,—Can you inform me where commercial sulphuric acid, approximately free from arsenic, can be obtained? The firm from whom we have till now obtained our chemicals say that the only sulphuric acid free from arsenic which they can now supply is at the rate of a shilling per pound.

Is there any reason why sulphuric acid made from sulphur should not now be obtained just as easily as formerly? It is inconvenient (not to say dangerous) to allow boys to make hydrogen from sulphuric acid containing so much arsenic that the gas burns with a brilliant white flame, and it is not economical to have to purchase sulphuric acid for such purposes at the price of a shilling per pound.—I am, &c.,

W. MARSHALL WATTS.

Giggleswick Grammar School,  
Near Settle, Yorkshire.

### ON THE DETERMINATION OF THE ORGANIC MATTER IN POTABLE WATERS.

*To the Editor of the Chemical News.*

SIR,—The late Dr. Matthiessen is credited with the remark that the ammonia-process of water-analysis had one fault, and one fault only, viz., that it was invented by Wanklyn, Chapman, and Smith. The paper of Professor Dittmar which you have just published (*CHEM. NEWS*, vol. xxxvi., p. 26) tempts me to add that there was a much more serious fault in the process, viz., that it was brought out before its time, and that the difficulties which its inventors encountered and sought to surmount were difficulties which had not risen above the horizon which bounded the mental vision of their contemporaries.

In making this remark I mean nothing disrespectful to Prof. Dittmar, but the reverse, since, observing that he is

absolutely unconscious of that which ten years ago appeared to us to be self-evident, I do not accuse him of any stupidity, but say that his want of discernment is the fault not of himself, but of the times in which he lives.

The passage in Prof. Dittmar's paper to which I take especial exception is this:—"While Mr. Wanklyn himself, on the other hand, would surely be the last to deny that his method, in its present form, is far from being so absolutely constant in its results as not to be at all the better for being supplemented by a determination of the organic carbon and total organic nitrogen."

To this Mr. Wanklyn replies that (as is well known) he holds that Frankland's organic carbon and organic nitrogen are, for the most part, unreal quantities, but he goes very much further than that, and maintains that if they were real,—that is to say, if the numbers in a Frankland water-analysis were the numbers expressing the real quantities of organic carbon and nitrogen in the water-residues which have been submitted to the ceremony of combustion,—even then they would be irrelevant to the question, and would afford no assistance to the analyst with the ammonia-process within his reach.

Ten years ago, when the ammonia-process came out, its authors were under the strong influence of this conviction, and to that influence chemists are indebted for the initiation of the process which has been so widely accepted.

My colleagues and I have induced contemporary chemists to adopt our process, but I look upon the task of bringing them to a comprehension of the merits of the process as much more difficult, and in putting forward the following considerations I have not much hope of being successful:—

When a chemist examines a sample of water, what he really wants to know is what the water contains; and what may happen to be in the water-residue can only be of interest to him in so far as it is a guide to what there was in the water that left the residue. In the case of the imperishable mineral constituents that are dissolved by the water, there is nothing illogical in resorting to the water-residue; but it is a stupendous absurdity, and to my mind it appears an incomprehensible act of folly, for the chemist to search the water-residue for the perishable organic *débris* which originally existed in the water.

The ammonia-process was our protest against that supreme act of folly. The organic matter in the water we attacked in presence of the water, and by so doing we gave a true solution of the problem in place of the sham solution which Dr. Frankland would have passed off if he had overcome the mechanical difficulties lying in his path.—I am, &c.,

J. ALFRED WANKLYN.

Laboratory, 117, Charlotte Street, Fitzroy Square,  
London, W., July 23, 1877.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 26, June 25, 1877.

**Heat Disengaged by Chemical Combinations in the Gaseous State: Anhydrous Acids and Water.**—M. Berthelot.—In this paper the author examines the combination of water with anhydrous nitric and acetic acids and with anhydrous chloral.

**Equivalent of Organic Compounds.**—M. Berthelot.—The author maintains that in organic as in mineral chemistry, the equivalent of water,  $\text{HO} = 9$ ; that of hydrogen,  $\text{H} = 1$ ; and that of acetic acid,  $\text{C}_4\text{H}_4\text{O}_4 = 60$  represent three correlative weights.

**New Anthophyllite from Bamle, in Norway.**—M. Des Cloizeaux.—Anthophyllite, essentially consisting of silica, ferrous oxide, and magnesia, and very near in its chemical constitution to the group of the amphiboles, from which, however, it is distinctly divided by the rhomboid type of its crystals, offers new analogies with some of the members of this important group. Like to them it may contain a large proportion of alumina, and it possesses a marked tendency to form pseudomorphs.

**Phosphate of Lime Glass.**—M. Sidot.—The acid phosphate of lime is transformed by heat into an entirely crystalline body. This substance, which the author calls pyrophosphate of lime, if exposed afresh to a higher temperature, becomes perfectly vitreous, giving up a part of its elements, and descending probably to the state of tri-basic phosphate of lime,  $3\text{CaO}, \text{PO}_5$ . The glass thus obtained is perfectly transparent; its index of refraction is 1.523, that of crown glass being 1.525. Its specific gravity is 2.6. It is not attacked by acids in the cold, but it is acted on by boiling acids and potassa. It is not affected by hydrofluoric acid.

**Dissociation of Carbides by means of a Palladium Wire, and on the Connection of the Facts with Catalytic Phenomena.**—M. J. Coquillion.—If the proto-carbide or bicarbide of hydrogen is passed over a spiral of palladium at a dull red-heat the gaseous volume is not sensibly affected, but if it is raised to a white redness, after cooling a considerable augmentation of volume is observed, and on the cooler part of the wire is found a pulverulent deposit of carbon, resulting from the dissociation of the carbides. The hydrogen is set at liberty. With platinum wire a decided increase of volume has not been obtained.

**Determination of Potassa.**—M. A. Carnot.—Reserved for insertion in full.

**Nickeliferous Iron of Santa Catarina, in Brazil.**—M. Guignet.—This deposit, which was probably a meteorite, is exhausted.

**Description of Several Minerals.**—F. Pisani.—The species described are the triphane of Brazil, the anthophyllite of Bamle, the tephroite of Langban, in Sweden, and the pharmacosiderite of the mine of La Garonne (Var).

*Les Mondes, Revue Hebdomadaire des Sciences,*  
No. 7, June 14, 1877.

This issue contains no original chemical matter.

No. 9, June 28, 1877.

The Swiss Society of Natural Sciences will meet this year at Bern, in the canton of Vaud, from the 19th to the 27th of August, under the presidency of M. Louis Dufour, of Lausanne.

M. Tremeschini, of Paris, has constructed a sensitive metallic thermometer on a new principle. The expansions of a small leaf of platinised silver are augmented by means of a system of levers, and the movement is communicated to the needle of a graduated scale. The action of the needle is instantaneous.

MM. Deprez and Napoli have constructed a new instrument for ascertaining the relative value of lubricating oils. The apparatus consists essentially of two plates, one of which is movable and may take different known speeds, whilst the other, also movable, is pressed against the former by weights arranged previously, and retained in its place by a ribbon of steel attached to a dynamometer. Each experiment lasts some hours.

At Neubourg (Eure) is a well the waters of which are charged with oxygen; 4 litres hold 83 c.m. of air in solution, of which 44.6 per cent (by measure) is oxygen and 55.4 nitrogen. The water is found to whiten linen very well, and does not attack the hands. The amount of mineral matter is 0.9688 grm. per 4 litres.

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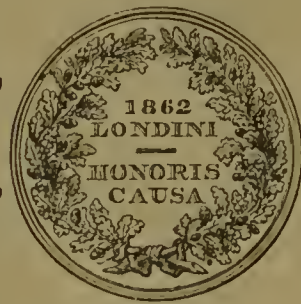
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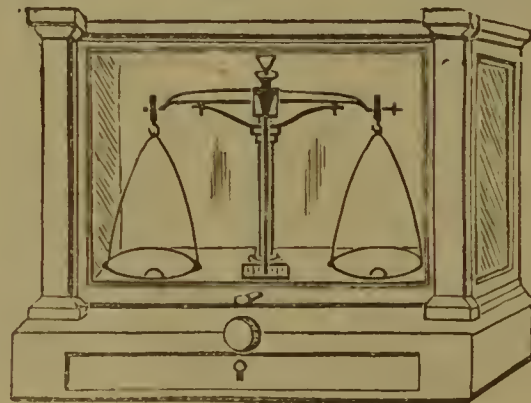
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# THE CHEMICAL NEWS.

VOL. XXXVI. No. 923.

## ON REPULSION RESULTING FROM RADIATION.—PART IV.\*

By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 36.)

191. To obtain the nearest approach to the theoretical curve of intensity from my results, it will not be right to take the mean of all my observations. The error can only be on one side—that of deficiency. Therefore the lower observations must be rejected, and the highest results only taken.

Bearing in mind that the spectrum formed with glass prisms is condensed at the red end and expanded at the blue end, it would appear from an inspection of the curves, that, with a normal spectrum, such as a diffraction-grating would give, the maximum of action should be at a little below A in the ultra-red, and that the curve should descend equally on each side.

192. This appears to be the most appropriate place to discuss the question which, from its being almost invariably asked the first, seems to be of the greatest interest to most inquirers:—"Is the effect due to *heat* or to *light*?"

I cannot answer this question. The terms *heat* and *light* are not definite enough. The physicist has no test for light independent of heat. Light and colour are physiological accidents, due to the fact that a small portion near the middle of the spectrum happens to be capable of affecting the retina of the human eye. There is no real distinction between heat and light; all we can take account of is difference of wave-length; and all we can see in the spectrum is one continuous series of vibrations, longer at the red end than at the violet end, but extending in an unbroken series for an unknown distance on each side. I say unknown; for it is probable that the whole spectrum, as we know it, is limited by the imperfect transparency of the atmosphere, or of the refracting medium, for the extreme ultra-red and ultra-violet rays.

Take a ray of the spectrum of a definite wave-length (the line B for instance), and allow it to fall on a thermometer; the mercury rises, showing the action of *heat*; concentrate it on the hand by a lens, it raises a blister accompanied with pain; let it fall on a bismuth and antimony couple, the galvanometer is deflected; and this action we also call one of *heat*. Let the ray fall on the eye, and it produces the sensation of *light* and *colour*. Let it fall on a collodion plate prepared in a particular manner, and it gives a permanent image, showing that it can cause *chemical action*. Lastly, throw the ray on a portion of matter free to move in a vacuum, and it makes itself evident as *motion*. Now these actions of *heat*, *light*, *colour*, *chemical action*, and *motion* are inseparable attributes of the ray of that particular wave-length; and to consider that there can be a splitting-up of this ray into two or more rays of the same refrangibility, one having the property of light, the other of heat, &c., is to my mind an absurdity.

The longer waves of the spectrum are those most able to produce heating-effects, the shorter waves best cause chemical action, and the intermediate waves easiest excite the sensation of vision; but although the maxima of these actions are at different parts of the spectrum, each effect can be detected at any part.

In a similar way the production of motion has its maximum in the waves situated at the ultra-red part of the spectrum, whilst it is capable of being rendered evident in all parts. This at first sight would favour the supposition that the action was due to the heating power of the waves.

193. How far this is really the case may be seen by the following Table, in which I have reduced the maximum to 100, and given the motion-producing value of the different colours of the spectrum, reduced in the same proportion:—

Ultra-red .. .. .	100
Extreme red .. .. .	85
Red .. .. .	73
Orange .. .. .	66
Yellow .. .. .	57
Green .. .. .	41
Blue .. .. .	22
Indigo .. .. .	8½
Violet .. .. .	6
Ultra-violet .. .. .	5

A comparison of these figures with those usually given in text-books to represent the distribution of heat in the spectrum will be a sufficient proof that the mechanical action of radiation is as much a function of the luminous rays as it is of the dark heat-rays.

194. In the intervals of spectrum work I tried many other experiments with the apparatus. I was anxious to get the exact time of the oscillations of the beam in a vacuum, and tried many ways of starting the initial impulse.

A candle held close to the screen, and the shutter momentarily opened and closed, sent the index with some violence to the extreme limit of the scale. It then slowly came back to zero and there stopped. Magnesium wire used in the same way produced the same effect. There was no oscillation, as there would have been if the impulse had been given by a material blow. The movement of the beam, as shown by the spot of light, seemed as if it were held in check by a force acting the whole time of its movement, and not only for the time the light acted. The impression conveyed was that the beam was swinging in a viscous fluid, and the more perfect the vacuum the greater appeared to be the viscosity (107). Thinking that the heat-rays from the candle might be absorbed by the black pith and so raise its temperature, I interposed screens of water, alum, and thick plates of glass, so as to cut off the ultra-red rays. Still the apparent resistance to free oscillation continued.

I then, without interfering with the vacuum, and without letting radiation fall on the pith surface, gave the apparatus a sudden twist round, so as to cause the beam to knock against the side of the tube. This set it swinging through a large arc, and the oscillations kept up with perfect freedom for several minutes, declining in amplitude at each oscillation till the beam ultimately came to zero. This perfectly free movement is in strong contrast to the constraint under which the beam moves when the initial blow is given by a ray of light instead of by a mechanical push.

The same effect was noticed during the experiments with the spectrum. A ray in the blue, falling on the pith, would drive the index twenty divisions along the scale. It would then gently come back to zero, where it would stop, occupying the same time to come back as it did to go forward. If, however, after the action of the light had entirely ceased, I gave the tube a slight jerk, so as to cause the beam to swing through the same arc, the index on returning to zero would pass perhaps 15 degrees the other side, and would thus oscillate for some time from one side to the other of zero, taking many minutes to come to rest.

195. This phenomenon enables me to advance a step towards an explanation of the mechanical action of radiation, although I fear I shall have to make some assumptions which are scarcely yet proved.

\* A Paper communicated to the Royal Society, February 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

A ray of light falls on a white surface and is reflected back again; it does no work there (170, 171); but if the ray falls on a black surface it is absorbed and quenched. What becomes of it? It seems to me probable that the ray becomes converted into thermometric heat, and that its energy is in whole or in great part used up in raising the temperature of the dark body. But having thus become warm, the powerful radiating action of the surface for heat comes into play, and the heat, which has just been engendered and absorbed, is quickly radiated back again. It would appear as if this radiation of heat from the surface of a body caused the latter to retreat backwards, and so produced the motion. This would account for the apparent viscosity of the vacuum; for the heat radiating from the black surface of the pith would act in opposition to the torsion, and hold the latter force in check till it was itself all dissipated. The superiority of pith over metal is also accounted for. Pith is one of the worst conductors of heat, and thus allows all the heat to radiate from the same surface which absorbed it; whilst metals, being the best conductors of heat, allow it to pass through and radiate almost as much from one surface as the other.

The slight action of the blue rays is thus due to their short vibrations not being capable of transmutation into so much thermometric heat as are the longer rays; whilst the strong action of the red rays is owing to the degradation necessary to convert them into heat being but slight.

This action is parallel to that of the production of phosphorescence. A ray of such high refrangibility as to be invisible falls on a suitable surface; it is there absorbed, degraded in refrangibility, and radiated out again in the form of visible rays of longer wave-length. We have only to imagine our eyes to be unaffected by what we now call light, but capable of responding to an octave lower in the spectrum, and we should see the same thing when the blue ray falls on the blackened pith. In such a case an invisible beam would be thrown on a suitable surface of lampblack; the latter would instantly respond, lowering the refrangibility and increasing the wave-length to the point of visibility; the ray so generated would be absorbed and then radiated back again, the lampblack surface glowing with light for some time after the original ray had ceased to fall on it.

196. Making use of the property discovered by Dr. Tyndall of the almost perfect transparency for the invisible heat-rays of iodine dissolved in disulphide of carbon, and its opacity to the luminous rays, experiments were instituted with a view to obtain a numerical comparison of the mechanical action which was due to the invisible rays and that due to the visible rays.

The apparatus was used as fitted up for spectrum observations (187), the prisms and lenses being removed. A ray of sunlight was reflected from the heliostat, then reflected by means of a right-angled prism (placed in the usual position of the refracting prisms) into the apparatus.

The action of the sunlight was far too powerful for the apparatus, and I accordingly passed it through a plate of alum, a thick piece of glass, and an empty glass cell.

On opening the shutter the pith was powerfully repelled, the index ray moving 300 divisions. The cell was filled with disulphide of carbon, and the experiment again tried. The index moved to the same point.

The clear disulphide of carbon was removed, and it was replaced by a strong solution of iodine in disulphide of carbon. This was opaque to the sun's ray. On opening the shutter the deflection amounted to  $79^\circ$ .

This experiment shows that the total radiation from the sun, passing through alum and glass screens, produced a deflection of  $300^\circ$ , whilst if the whole of the light was cut off by interposing a solution of iodine in disulphide of carbon, there was still a movement of  $79^\circ$ . This  $79^\circ$  was the effect due to dark heat which penetrated the alum, the difference ( $221^\circ$ ) being due to light.

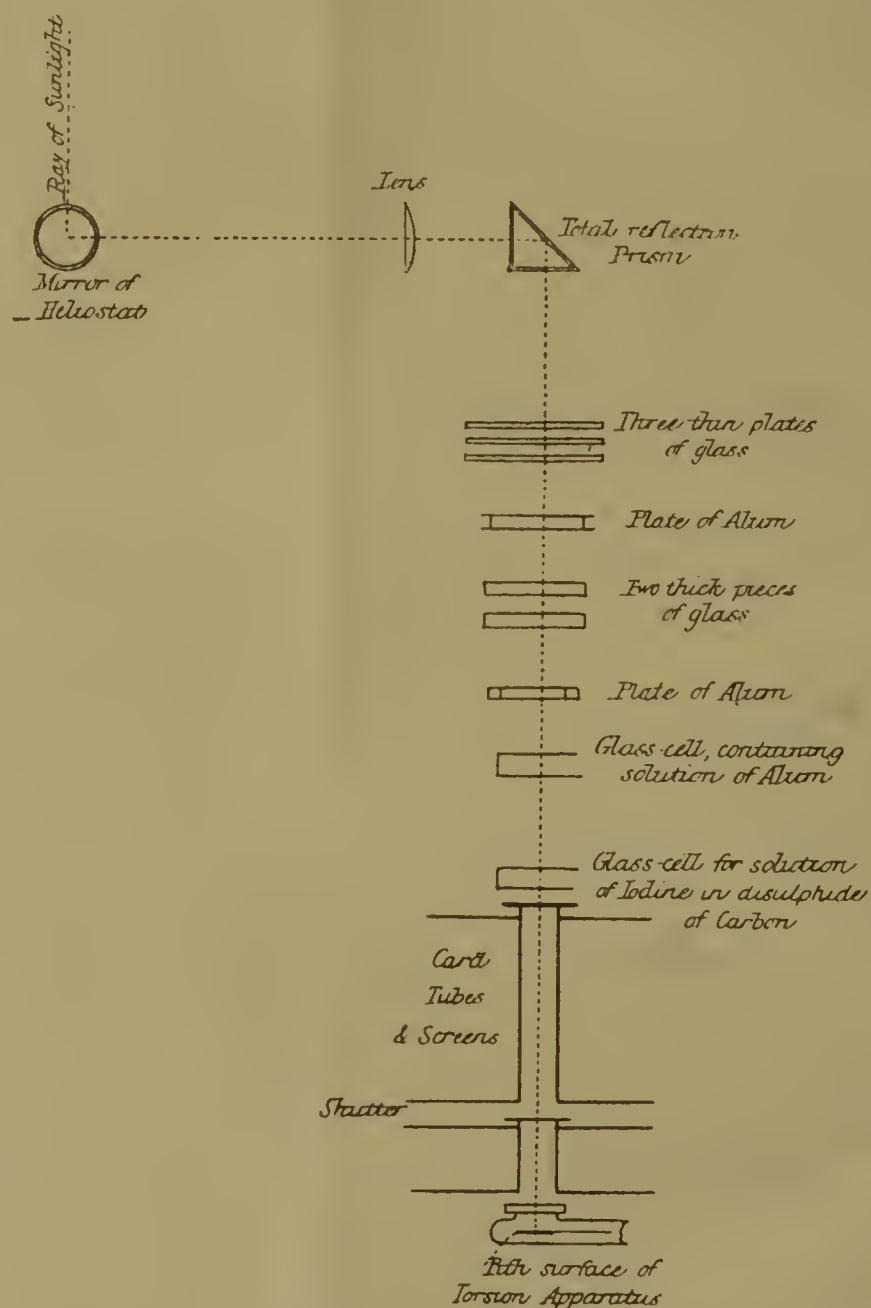
I endeavoured to cut off the whole of the dark heat, so as to work with the luminous portion only of the solar

radiation. The ray of sunlight reflected from the heliostat was accordingly passed through the following screens, placed one behind the other, as shown in fig. 15:—

- A lens.
- A thick, total-reflection, right-angled prism.
- Three thin plates of glass.
- A plate of alum  $7\frac{1}{2}$  millims. thick.
- Two thick glass plates.
- Another plate of alum, 5 millims. thick.
- A glass cell full of saturated solution of alum.
- An empty glass cell.

It was expected that these numerous cells would effectually cut off the dark heat-rays. To prove this the empty cell was filled with opaque disulphide.\* On opening the shutter the deflection of the index was  $2^\circ$  only.

FIG. 15.



What came through the alum, glass, and water screens was therefore pure light, practically free from the dark rays which are called heat.

The opaque disulphide was then replaced by clear disulphide. The deflection was  $105^\circ$ .

Action of  
filtered sunlight.

Opaque disulphide .. .. .	2 degrees.
Clear disulphide .. .. .	105 ..

Deducting the  $2^\circ$  as representing the trace of dark heat which escaped the alum, glass, and water screens, the difference ( $103^\circ$ ) represents the action of the luminous portion of solar radiation and of that small quantity of the ultra-violet rays which would pass the screens; for had the effect of the sun's radiation after passing through the screens been due to *heat*, on cutting off the *light* by means

\* For the sake of brevity I call the solution of iodine in disulphide of carbon *opaque disulphide*; the disulphide of carbon alone I call *clear disulphide*.

Of opaque disulphide, the deflection should have been practically undiminished. But experiment shows that, after passing through the screens, the repulsion due to heat is less than 2 per cent of the total action of the solar ray.

The screens, whilst diminishing the heat almost to nothing, also cut off a considerable quantity of the light.

197. A similar series of experiments was tried with the radiation from a candle. No alum, glass, or water-screens were at first interposed, and the deflections were taken with the clear and opaque disulphide, alternately put in the path of the ray. The candle was 3 feet off. The mean of several experiments were as follows:—

Opaque disulphide .. .. .	28 degrees.
Clear disulphide .. .. .	130 „

This shows that much of the action of a candle is due to rays which pass through iodine, *i.e.*, to the ultra-red rays.

The candle was now brought 2 feet from the apparatus, and the alum and glass screens were interposed. On repeating the experiments the mean result was as follows:—

Opaque disulphide .. .. .	5 degrees.
Clear disulphide .. .. .	37 „

(To be continued.)

## REPORT

### ON THE METHODS EMPLOYED IN THE ESTIMATION OF POTASH AND PHOSPHORIC ACID IN COMMERCIAL PRODUCTS,

AND ON THE

### MODE OF STATING THE RESULTS.\*

(Concluded from p 39.)

#### II. STATEMENT OF THE RESULTS OF ANALYSES OF POTASH SALTS.

YOUR Committee has devoted considerable attention to the difficult question of the proper mode of stating the results of analyses of potash salts. Hitherto the statements of various analysts appear to have been characterised by a lamentable want of system, and in many cases they are greatly at variance with the generally accepted principles of chemical combination and double decomposition.

The Committee has been furnished with copies of analyses of potash salts in which carbonate of potassium is reported as co-existent with sulphate and chloride of sodium, and the cases are numerous in which similar anomalous statements occur.

These various modes of statement are by no means solely due to eccentric notions respecting chemical affinity, but appear in many cases to be owing to the desire to attribute as high or low, (as the case may be), a commercial value to the article analysed, as is compatible with its percentage composition. Thus, a commercial carbonate is chiefly valuable on account of the potassium carbonate it contains, and therefore if the whole of the potassium be stated as existent in that form, while the valueless sulphate and chloride are relegated to the sodium, the *apparent* value is considerably greater than if only that portion of the potassium be assumed to exist as carbonate which is in excess of the quantity necessary to combine with the more powerful salt radicals.

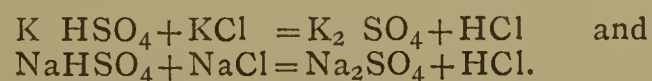
The Committee believes it would be practically impossible to lay down general rules for statement of results which, if followed, would necessarily and invariably lead

to an exact and scientific statement of the mode of existence of the various metals and salt radicals in a complex commercial salt of potash, but it is of opinion that, whatever modifications in detail individual analysts may think proper to adopt, the following general principles should be adhered to:—

1. The plan should be adopted of combining the strongest metal with the strongest salt-radical, after due allowance for the tendency to form insoluble or nearly insoluble salts. Thus the soluble calcium should always be stated as existent as sulphate. The excess of the salt-radical should be combined with potassium on the ground that chloride, nitrate, or carbonate of potassium is incapable of co-existence with sodium sulphate.

In the case of artificial or acid sulphates produced by treating “muriates” with vitriol the Committee is of opinion that the free acid is sulphuric acid, not hydrochloric acid. The reason for this opinion is to be found in the fact that any free hydrochloric acid would inevitably have been volatilised at the temperature employed in the production of the sulphate. The same remark applies to sulphuric acid if actually free, but, if in combination with sulphate of potassium to form an acid salt, it might resist decomposition. The acid salt here mentioned as a compound of sulphuric acid and sulphate of potassium would be more correctly described as potassium hydrogen sulphate,  $\text{KHSO}_4$ , but your Committee believes that the practical inconvenience of stating a certain amount of potassium in this form and the rest as neutral sulphate would outweigh any advantage to be derived from a scientifically exact statement.

It is evident that the presence of free sulphuric acid or of an acid sulphate in artificial sulphates can only be due to imperfect admixture of the vitriol and muriate, otherwise the following well-known reactions would have taken place:—



In the event of the bulk of the muriate consisting of chloride of potassium it may be argued that there is a greater probability of that salt remaining unacted on than that chloride of sodium should remain undecomposed, but it is evident that the circumstances are such as must vary with the conditions of each case, and your Committee therefore prefers to recommend the adoption of the arbitrary assumption that all potassium exists as sulphate, provided that there is sufficient of that salt-radical present to combine with the whole of the potassium after allowing for the free acid and the sulphate of calcium.

On the other hand it may be argued that as sulphates are always converted into carbonate or caustic alkali, any chloride present in the sample would ultimately be lost in the worthless form of chloride of potassium, whatever the metal with which it was originally combined. This argument has considerable force, and to meet it the Committee recommends that all statements of the results of the analyses of artificial sulphates should have appended the equivalent in chloride of potassium of the chloride found. In artificial sulphates there is considerable probability that the chlorine exists chiefly, if not wholly, as chloride of potassium, but such cannot be assumed to be the case with other sulphates, and in the statement of the composition of those the Committee considers the above calculation undesirable from a scientific point of view, though it is clear that there are other considerations in its favour.

The distribution of the salt-radicals among the remaining metals (sodium, magnesium, and iron) appears to the Committee to be a matter of indifference, as the precise arrangement will not affect the value of the sample nor cause any alteration in the sum of the constituents, while there appears to be no reliable evidence of the actual mode of combination.

In the case of “muriates” and sulphates having an

\* Report of a Committee of Section B., British Association, consisting of E. C. C. Stanford, James Dewar, Alfred E. Fletcher, E. W. Parnell, T. R. Ogilvie, and Alfred H. Allen (Secretary). Drawn up by Alfred H. Allen.

alkaline reaction, such as those made from kelp and beet-root, potassium and sodium are the only two metals present in more than traces. In the statement of all such analyses your Committee is of opinion that the only proper method is to calculate the potassium as sulphate, chloride, and carbonate in succession, and assuming no sodium to exist as sulphate or chloride unless the amount of potassium present is insufficient to satisfy the latter or both of those salt-radicals.

The impossibility of the co-existence of sodium sulphate or chloride with potassium carbonate is proved by the fact that double decomposition occurs when solutions of these salts are mixed and concentrated. The non-deliquescent character of kelp sulphates and muriates also furnishes a strong independent proof of the absence of potassium carbonate.

The same principles apply to the statement of the results of the analyses of commercial carbonates of potassium, and in their case its adoption becomes still more important.

In the case of nitrates only that portion of the potassium can be properly considered to exist as nitrate which is in excess of the quantity required for calculation as potassium sulphate (after allowing for the sulphate present as calcium sulphate). Whether some of the potassium will also exist as chloride, or whether there will be some sodium nitrate present, must depend on the respective amounts of potassium and  $\text{NO}_3$  found; but having regard to the well-known reaction  $\text{KCl} + \text{NaNO}_3 = \text{NaCl} + \text{KNO}_3$ , your Committee is of opinion that presence of both chloride of potassium and nitrate of sodium in the same sample is improbable.

In brief, the Committee is of opinion that in calculating the results of analyses of potash salts, the following method should be adhered to in combining the various metals and salt-radicals present in the portion of the sample soluble in water.

Basic hydrogen, which is met with only in artificial sulphates, exists as sulphuric acid, or more strictly speaking as potassium hydrogen sulphate,  $\text{KHSO}_4$ .

Calcium does not occur in practice in excess of an equivalent amount of sulphate, so that it should always be calculated to  $\text{CaSO}_4$ . The remaining constituents of the soluble portion of the sample should be arranged on the principle of combining the strongest metals with the strongest salt-radicals.

The order of affinity which the Committee considers most in accordance with observed facts and theoretical propriety is shown in the following list, in which the strongest metals and salt radicals are placed first.

Potassium	Sulphate
Sodium	Nitrate
Magnesium	Chloride
Iron	Carbonate.

The Committee is of opinion that in all cases in which one of the constituents of a sample is determined by subtracting the sum of the others from 100.00, the fact ought to be indicated in the statement of results. This can readily be done by appending the words "by difference" or "estimated by difference" to the name of the constituent thus determined. The adoption of this plan would obviate many of the disadvantages attendant on indirect determinations, but the Committee strongly recommends the employment of direct processes whenever possible.

In all cases where such a course is possible it is very desirable that the various compounds of potassium present should be calculated into the salt which the name of the article indicates as the leading constituent of the sample. In the case of sulphates, muriates, and carbonates, the corresponding amount of anhydrous potash should be stated. Thus the Committee recommends that an analysis of a German muriate should be stated somewhat in the following manner:—

Per Cent.	=Potassium Chloride.	=Anhydrous Potash.
Calcium sulphate ..	—	—
Potassium sulphate A	<i>a</i>	<i>x</i>
Potassium chloride B	B	<i>y</i>
Sodium chloride ..	—	—
Magnesium chloride..	—	—
Insoluble matter ..	—	—
Water .. .. .	—	—
100.00	B + <i>a</i>	<i>x</i> + <i>y</i>

In the case of carbonates, the anhydrous potash corresponding to the carbonate of potassium present, should always be stated separately from that calculated from the sulphate and chloride, as it is only in certain cases that the potassium existing in the latter forms is of any value.

ERRATA.—On page 38, col. 2, line 32 from bottom, *for* "when heavy metals" *read* "when *no* heavy metals." Page 39, col. 1, line 19 from top, *for* "was found to exceed" *read* "was *not* found to exceed."

## ON THE SOLUBILITY OF THE ALKALIES IN ETHER.\*

By WILLIAM SKEY,

Analyst to the Geological Survey of New Zealand.

It has hitherto been supposed by chemists that the alkalies are insoluble in ether, but having been led to doubt the truth of this supposition, from observing certain facts which lately came under my notice, I at once set to work to investigate the matter, and, as it is one of some importance in connection with toxicological examinations, I think it proper to submit the results of this to you.

My experiments for this purpose were performed both with hydrous and anhydrous ether.

Taking first the hydrous ether—that is the commercial article, and that which we really have to deal with in the kind of examinations above alluded to—I agitated separate portions of it with an aqueous solution of caustic potash and carbonate of soda (common soda), then decanted the ether off into clean test-tubes, and again from these tubes into platina vessels. I then allowed the liquids to evaporate, when I found the residues resulting from this had a very alkaline reaction, and which was persistent when they were gently ignited and dissolved in water, clearly showing that a fixed alkali was present in both cases in a free state, or at least as a carbonate. Both magnesia and lime also dissolve in this kind of ether to a notable extent. Bicarbonate of soda, however, hardly appears to do, or, if so, only in minute quantities.

In regard now to the solvent power of ether itself—that is, the anhydrous substance—I find that, when this is mixed with dry potassic hydrate, allowed to clear, and then decanted off, a marked alkaline reaction is also obtained by dipping reddened litmus-paper into it, and which is more intense than can be occasioned by any minute trace of alkaline acetate possibly present in the ether, resulting from an inter-reaction of the potash upon it.

The alkalies and their inferior carbonates, therefore, not being insoluble in ether, and alkaloidal carbonates being, as I find, freely soluble therein, I would recommend in special cases, for isolating and obtaining pure alkaloids by Stas's process, the use of bicarbonate of soda, or, better still, an earthy carbonate, in place of caustic alkali, as now employed in aid of this.

I may perhaps be permitted to state further, in reference to the solvent property of anhydrous ether, that I find many salts are soluble to a notable extent in it which are insoluble, or nearly so, in that which is hydrous; for instance, the chlorides of calcium, nickel, zinc, cadmium,

\* Read before the Wellington Philosophical Society, January 29, 1876.

and platinum,—also the sulphocyanides of nickel, copper, and zinc. The addition of a small quantity of water to any of these ethereal solutions generally renders them very turbid, as the salt they contain is thereby precipitated as a hydrate. By the use of anhydrous ether, and by conducting the necessary evaporations in dried air, it is in fact possible to form many saline compounds hardly—if at all—producible otherwise. In this way I have prepared double sulphocyanides of nickel, and even of copper, with certain alkaloids, using chloride of calcium to dehydrate the saline solutions requisite for this.

## ON SOME SIMPLE LABORATORY MANIPULATIONS.

By Dr. P. TOWNSEND AUSTEN.

### I.

THERE are many little operations performed in the Laboratory which, although they are not of great importance, are still often of convenience to the working chemist. Sometimes a simplification or improvement of these little processes may save much labour and annoyance.

#### *Use of Felt Pads in Protecting Glass Vessels.*

The destruction of glass vessels is dependent on many causes. The vessel may stand on grains of sand which scratch the glass. If the glass is not well tempered it may sometimes, on being slightly scratched by these grains of sand, suddenly go to pieces, somewhat in the manner of a Prince Rupert's drop. If stone surfaces are used on the Laboratory tables, accidents occur continually. Vessels, if not placed very carefully on the slabs, may be struck against them. Or if a glass vessel containing a hot liquid be placed on a cold stone surface, the glass around the bottom is quite certain to crack.

After trying various means of prevention, I found that pads of felt were by far the best mediums for protecting glass vessels.

Felt, about half an inch in thickness, such as is used in restaurants for placing under beer-glasses, or for roofing purposes, can be bought at a very moderate price. It should be cut up into squares, or, better, into oblong pieces ranging from 2 × 4 inches to 8 × 12 inches. A beaker filled with a hot liquid—boiling sulphuric acid, for instance—may be placed with perfect safety on one of these pads. The felt is a very poor conductor of heat, and the glass hence preserves its temper admirably. Neither is there enough resistance offered to the glass surface to allow it to be scratched by any grains of sand which may perchance be on the felt. By striking the pads against the table all sand and grit may easily be removed from them.

The softness of the felt removes all chance of breakage, and it is really remarkable how long a set of beakers will last when always allowed to cool off on felt pads.

If the pads get wet a day in the air-bath will restore them.

I make it a rule, in my work, to have a pad under every piece of glass apparatus on my Laboratory table. If felt cannot be obtained, pads of thick carpet may be used with good effect.

#### *The Examination of Crystals by the Microscope.*

In chemical research the microscope plays an important part in revealing the presence of crystalline substances in solutions. The usual method of preparing substances for examination by the microscope when, as in the Laboratory, fine microscopes, animalculæ, cages, and other conveniences are not at hand, is to evaporate some of the solution on a watch-glass over a micro-chemical gas-flame, and then rub with a glass rod, when the crystals begin to grow on the minute scratches in the glass, and thus set up a general crystallisation. The crystals formed in this manner, however, are rarely satisfactory, being

often broken, misformed, or mixed with a large amount of the substance in a partially amorphous state.

If the solution be evaporated to the right consistency in a watch-glass, and another watch-glass of the same size previously warmed, be placed upon it, the drop expands to a film. The upper glass should not be pressed, but allowed to rest of itself. The film is similar to the one obtained in an animalculæ cage, being, however, thicker. If now a few drops of ether be placed in the upper watch-glass, the cold caused by the evaporation of the ether will cause a crystallisation to take place between the watch-glasses. The growth of the crystals can be quite accurately managed by increasing or diminishing the cold on the surface (by blowing on the ether).

The crystals formed are, as a rule, perfect in shape. I have by these means obtained well-defined crystals from solutions which, by rubbing with glass rods, afforded me only amorphous powders.

New York School of Mines,  
April 1, 1877.

## ON THE CONTROLLING OF THE ESCAPES OF SULPHUR GASES IN THE MANUFACTURE OF SULPHURIC ACID.\*

By JAMES MACTEAR.

THE escape of sulphur gases into the atmosphere from the combustion of coal, and the manufacture of sulphuric acid, has recently assumed great importance from the interest attached to the investigations of the "Noxious Vapours Commission."

In the case of coal the escape is quite beyond our control, except in so far as the economy of fuel is involved in the question, but the case is different in the manufacture of sulphuric acid, where it should be reduced to lowest possible point.

Most sulphuric acid makers place great reliance on their yields of oil of vitriol (or of sulphate of soda) as a measure of the efficiency of their management; and so it would be were it not for the difficulty of obtaining accurate figures. But the question is so involved in doubt as to the correctness of stocks and consumption of raw materials and produce, the accuracy of measurements, temperatures, specific gravities, and calculations, that the question of "production" may be discussed *ad nauseam* without advancing one step beyond the point of personal belief.

This being so, I decided many years ago to adopt as a general principle, that it would be much more satisfactory to know what was lost rather than approximately what was obtained; and it is on the application and results of this principle that I purpose treating in this paper.

It has been customary with many manufacturers to make occasional tests of the residual gases escaping from their vitriol chambers; but I believe I have been the first to introduce continuous testing in terms of actual loss.

I began the investigation connected with this subject so far back as 1866, but it was only in 1874 that the present system was finally worked out and in operation.

The apparatus consists of a Bunsen pump for aspirating the gases, an absorbing apparatus suited to the requirements of the operation, and a meter to measure the volume of the residual gases after absorption.†

The application of this arrangement to the vitriol chamber escapes is very simple. The apparatus is connected with the outlet of the Gay-Lussac towers or chambers; and set in operation, we thus obtain results

\* Read before the Newcastle-upon-Tyne Chemical Society March 22, 1877.

† This apparatus is equally applicable to continuous testing of other gases, and a modification of it has recently been applied with great success in the examination of the air of large towns by Mr. E. M. Dixon and Dr. Russell.

showing the sulphur gases escaping per cube foot. We now require to know what relation this figure bears to the actual loss of sulphur, and the following calculation will illustrate the matter. It has as yet been found extremely difficult to estimate the cubic feet of residual gases passing in the outlets with accuracy by any form of anemometer, and I have relied on the oxygen determination, which should form a regular part of the testing in a vitriol manufacturer's laboratory, to enable him to calculate the residual gases passing.

To illustrate the subject let us assume that we are employing pure  $\text{FeS}_2$  and perfect combustion taking place; let us also take the following data for calculation:—

	Atomic Weight.
Hydrogen .. .. .	1.00
Nitrogen .. .. .	14.02
Oxygen .. .. .	15.96

Taking the crith as 0.0896 grm., 1 litre will weigh at the standard temperature, of 0° cent, and 760 m.m. Bar.; of—

	Grammes.
Hydrogen .. .. .	0.0896
Nitrogen .. .. .	1.2560
Oxygen .. .. .	1.4300
Air .. .. .	1.2930

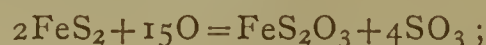
And a cubic foot being equal to 28.316 litres, the weight will be of—

	Grammes.	Lb.
Hydrogen.. .. .	2.5371136	0.00559337
Nitrogen .. .. .	35.5648960	0.07840731
Oxygen .. .. .	40.4918800	0.08926921
Air .. .. .	36.6125880	0.08071687

The composition of air being taken as—

	By Weight.	By Volume.
Oxygen.. .. .	23 parts.	20.8 parts.
Nitrogen .. .. .	77 „	79.2 „
	100 parts.	100.0 parts.

Let the basis of calculation then be one ton of pure  $\text{FeS}_2$  and we have the decomposition—



Or gravimetrically, 120  $\text{FeS}_2$  requires 120 O.

∴ 20 cwts. of  $\text{FeS}_2$  will require 20 cwts. of oxygen;

and as air contains 23 parts by weight of oxygen, 20 cwts. of oxygen will equal 87 cwts. of air containing 67 cwts. of nitrogen—this nitrogen being equal to a bulk of 95,705.3 cubic feet.

Assume, then, that in an apparatus burning pure  $\text{FeS}_2$  with perfect combustion, there is found in the escaping gases, after complete decomposition and condensation, oxygen equal to 10.00 per cent by volume, it is evident that if we take the air as containing 20.00 per cent of oxygen, the total volume of the escaping gases will be double the volume of the nitrogen; or,—

	Cubic Feet.
Nitrogen .. .. .	95,705.3
Air at 20.00 per cent O ..	95,705.3
	191,410.6

Volume of gases escaping, containing 10.00 per cent of oxygen.

Correcting this for standard temperature of 15.555° C. and Bar. 760 m.m., we get —

	Cubic Feet.
Nitrogen .. .. .	101,158.4
Air at 20.00 per cent O ..	101,158.4
	202,316.8

Cubic feet escaping.

The true percentage of oxygen in the air being 20.80, the correction will be  $X = V \times 0.926$ . Where X equals

volume of air of 20.80 per cent and V the volume of nitrogen in cubic feet, the corrected figures being—

Nitrogen.. .. .	101,158.4
Air of 20.80 per cent ..	93,672.6
	194,831.0

Cubic feet of residual gases containing 10.00 per cent of oxygen at the temperature of 15.555° C. and Bar. 760 m.m. air taken as containing 20.80 per cent of oxygen.

In practice we have to deal with pyrites containing, we will assume, 47.5 per cent of sulphur as  $\text{FeS}_2$ , as well as small quantities of lead, zinc, arsenic, &c. For practical purposes we may neglect the effect of these, and also of the nitrate of soda used; the ultimate figures will be but little affected by our doing so.

The general formula for calculating the available sulphur in the pyrites is:—

$$A - \frac{(B \times W)}{100}$$

Where A = per cent of sulphur in pyrites.

B = „ „ in residue.

W = weight of residue from 100 of pyrites.

With pyrites of 47.5 per cent of sulphur, yielding 70 per cent of its weight of residue, containing 3.57 per cent of unconsumed sulphur, we have—

$$47.5 - \frac{(3.57 \times 70)}{100} = 45 \text{ per cent available.}$$

Assuming this to exist as  $\text{FeS}_2$ , the volume of nitrogen due to the combustion of one ton of the above pyrites is obtained by the equation.

$$A - \frac{(B \times W)}{100} \times C = X.$$

C being a constant for air of 20.8 per cent of oxygen = 1897.9, and the air associated with the nitrogen by  $X \times C' = Y$ ,

C' being a factor corresponding to the percentage of oxygen in the escaping gases.

Then  $X + Y$  = total volume of residual gases.

Taking oxygen in residual gases to be 10 per cent after condensation or absorption of all sulphuric gases (either in chambers or absorbers employed in testing) we have for the case we are considering of pyrites of 47.5 per cent, &c.

Nitrogen Volume.	Nitrogen Volume.	Total Volume.
85,405.8 × 0.926	= 79,085.8	+ 85,405.8 = 164,491.6 cub. ft.

The total volume of residual escaping gases from one ton of pyrites, such as we are considering, 20 cwts. of which at 45.00 per cent available sulphur, will yield—

7,056,000 grains of sulphur,

which, divided by the cubic feet of residual gases escaping, would give 42.9 grains per cube foot were all the sulphur to escape; and as 100 of sulphur equals 306.25  $\text{H}_2\text{SO}_4$ , 42.9 grains per cube foot escaping would represent a loss of 306.25  $\text{H}_2\text{SO}_4$  on 100 of sulphur available, and consequently one grain of sulphur per cube foot equals a loss of 7.139  $\text{H}_2\text{SO}_4$  from 100 available sulphur.

Further, the available sulphur being in this case 94.737 per cent of the "sulphur bought," one grain of sulphur per cube foot equals—

$$\frac{94.737 \times 7.139}{100} = 6.76$$

Loss of  $\text{H}_2\text{SO}_4$  from 100 of "sulphur bought."

If the  $\text{BaSO}_4$  is weighed in grammes, then grammes of  $\text{BaSO}_4$  per cube foot × 14.26 will give the loss in terms of  $\text{H}_2\text{SO}_4$  per cent on "sulphur bought," or × 15.06 will give loss on "sulphur burned."

The meter, absorbing arrangements, and all cocks and

connections are in locked cupboards to prevent their being tampered with.

The meter is fitted with an index so arranged that by observing the reading for one minute the rate of passage per hour is given by direct indication, so that the rate of aspiration is easily regulated.

The pump may be constructed in various ways, the simplest form, which is a very efficient one, being a simple T-tube, the water being let in at the side. It is an advantage to have a trap introduced on the discharge pipe from aspirator, by which means a greater command is obtained over the apparatus.

The absorbing arrangement may be fitted up in so many ways that it need not be described here; in fact, so long as there is sufficient absorbing liquid to arrest the largest possible escape in an efficient absorbing apparatus, it matters little what is the arrangement adopted.

Caustic soda or ammonia, free from sulphur salts, are very suitable as absorbents, and it is as well to use a tube of permanganate of potash solution as a final washer to indicate if any excess has been passing over what has been absorbed in the apparatus.

An idea of the SO<sub>2</sub> escaping is readily got by titrating the solution from the absorbing tubes with permanganate; this can be done very rapidly, and is a good check on the working.

I have found that it is practically impossible to obtain steady results from sulphuric acid chambers worked on the ordinary system of inspection alone, by which I mean the indications afforded by colour (and smell!) of gas, drip samples, temperatures, &c., for while all seems to be going on rightly, the escapes vary in the most irregular way, and it is not until a considerable time after an irregularity has occurred in the working that it can be discovered by these indications; whereas on the other hand, by means of the check on the working of the chambers obtained by the continuous testing of the escapes, the management of the process is much simplified, and it can at once be discovered in the case of an excessive escape what has been the cause, when of course it is easily prevented.

The application of the apparatus I have described to sulphuric acid chambers, previously worked on the best known methods, has had the effect of at once reducing the escapes to a large extent.

## PROCEEDINGS OF SOCIETIES.

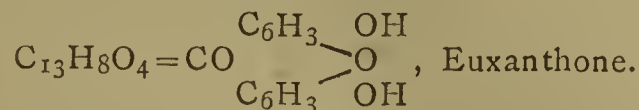
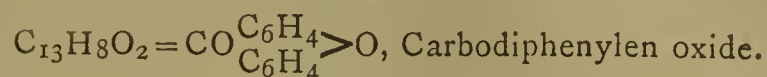
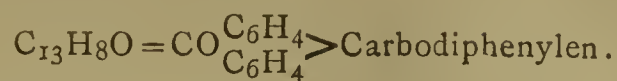
### DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

July 23rd, 1877.

Prof. A. W. HOFMANN, F.R.S., Vice-President, in the Chair.

Prof. H. W. VOGEL exhibited an ingenious "Support for a Pocket Spectroscope," by means of which the latter could be easily used for the accurate comparison of absorption-spectra and of flame spectra, or of either with the solar spectrum.

Prof. H. WICHELHAUS and M. SALZMANN communicated the results of an investigation "On the Constitution of Euxanthone," the body C<sub>13</sub>H<sub>8</sub>O<sub>4</sub>, obtained from the Indian dyestuff puree. It was found to form an acetyl compound containing two acetyl groups. On reduction with zinc it yielded benzene, phenol, and as chief product a solid body, C<sub>13</sub>H<sub>8</sub>O, which was easily oxidised to C<sub>13</sub>H<sub>8</sub>O<sub>2</sub>. These reactions, combined with the other well-known decompositions of euxanthone, led to the establishment of the following series of formulæ, according to which euxanthone would be the carbonyl of resorcin:—



Prof. WICHELHAUS presented for Dr. Förster a paper "On Amine Derivatives in the Amylic Series." The action of alcoholic ammonia on amylen bromide leads to the formation of several bases. The one chiefly examined is C<sub>5</sub>H<sub>10</sub>(NH<sub>2</sub>)<sub>2</sub>, which forms a finely crystallising compound with PtCl<sub>4</sub>.

Prof. C. LIEBERMANN has investigated the "Composition of Quinhydrone," the green compound resulting from the union of solutions of quinone and hydroquinone. It has hitherto been uncertain whether it contained 2 molecules of quinone and 1 of hydroquinone, or the reverse, or 1 molecule of each. In order to solve the question equal weights of quinone and hydroquinone were dissolved in water, and the solutions brought together. The resulting precipitate of quinhydrone was found to weigh but 7 per cent less than the original amounts, and by a determination of the solubility of quinhydrone most of this difference was accounted for. An increase of the amount of quinone solution to a fixed amount of hydroquinone solution produced no increase in the amount of the precipitate beyond that resulting from the action of equal weights upon each other. The same fact was found to be true for thymoquinone and thymo-hydroquinone. Quinhydrone must receive, therefore, the formula C<sub>12</sub>H<sub>10</sub>O<sub>4</sub>.

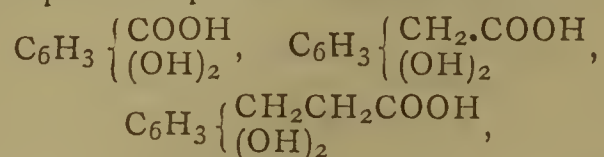
Dr. C. O. CECHE has prepared "Mono-chlor-acetanilide" by the direct action of aniline on mono-chlor-acetic acid, and finds the melting-point to be 134°.

Prof. A. W. HOFMANN has examined "A New Dye-stuff," of a bright red hue, which has lately been placed upon the market, and found it to belong to the same general class of bodies as the chrysoidin lately investigated by him (CHEMICAL NEWS, xxxv., 64). Analysis showed it to be the sodium salt of an acid, C<sub>16</sub>H<sub>12</sub>N<sub>2</sub>SO<sub>4</sub>. A body of this composition could be regarded as arising from the union of azo-sulphanilic acid and α-naphthol, or from diazo-naphthalen and a phenol-sulphonic acid, or from azo-naphthylamin-sulphonic acid and phenol, or finally from naphthol-sulphonic acid and diazo-benzol. The latter method was considered the most probable. A solution of sodium α-naphthol-sulphonate added to a solution of aniline nitrate and potassium nitrite yielded at once a deep red precipitate of notable tinctorial power. Purification by solution in ammonia, and precipitated with acids, showed the new acid to be perfectly identical with that obtained from the commercial dye.

Dr. F. TIEMANN and K. L. REIMER, "On the Phenol-dicarboxylic Acids Derived from Salicylic and Para-oxybenzoic Acids." The authors, in the endeavour to study more thoroughly the three aldehydo-oxy-benzoic acids, derived from salicylic acid and paroxy-benzoic acid, have submitted them to oxidation. The process is exceedingly difficult, and is not furthered by introducing an acetyl group into the hydroxyl group. It was observed that a careful fusion with KHO produced the same results as oxidation with argentic oxide or potassium permanganate, no molecular condensations taking place. The two aldehydo acids, C<sub>6</sub>H<sub>3</sub>(COOH)(OH)(COH), 1.2.5 and 1.4.5, yielded the same identical acid—the α-phenol-dicarboxylic acid, which Ost has already prepared in a different way—as would be expected from the present benzene theory. The acid, C<sub>6</sub>H<sub>3</sub>(COOH)(OH)(COH), 1.2.3, yielded a new acid, named β-phenol-dicarboxylic acid, which can be considered as a double salicylic acid. The solution shows a fine blue fluorescence. Salicylic acid is formed by the sublimation of the solid acid.

Dr. F. TIEMANN and N. NAGAI, "Synthesis of Ferula Acid, and Relations of this Acid to Caffic Acid and other Members of the Protocatechuic Series." The authors have

prepared ferula acid by means of Perkin's reaction from vanilline directly. The methyl-ferula acid is found to be identical with the dimethyl-caffeic acid, so that ferula acid must be considered as methyl-caffeic acid. By reduction hydro-ferula acid is obtained, and an iso-ferula acid has been prepared from methyl-ferula acid. The authors have now clearly settled the relations between the three homologous groups of the protocatechuic series:—



and prepared the various methyl derivatives, with the exception of an iso-homo-vanillic acid.

Dr. F. TIEMANN and K. U. MATSMOTO have prepared a number of "*Derivatives of the Isomeric Methyl-protocatechuic Acids*." These include more especially various ethers, and nitro and bromo compounds. Bromo-dimethyl-protocatechuic acid, when melted with HKO, is changed readily into gallic acid. The most favourable conditions for the preparation of iso-vanillic have also been studied.

The following communications have been received from non-resident members:

R. OTTO finds that the solid "*Dichloro-propionitrile*," obtained by the action of Cl on propionitrile, is a polymer of the liquid compound obtained at the same time, and that it is well adapted to yield higher condensation products. By treatment with finely-powdered silver meconic acid and similar compounds are prepared.

B. TOLLENS, "*Specific Rotatory Power of Cane-sugar*." The rule that this power is proportional to the strength of the saccharine solution is not found to be applicable for all cases, and the limits are established within which it is correct.

H. SCHMITZ presents a communication on the same subject.

H. HESSERT prepares "*Phthalic Aldehyd*" by the action of Zn and HCl on phthalic chloride. By treatment with alkalis the aldehyd is changed into a monobasic acid, which appears to contain the original compound plus water. Sodium amalgam yields the body  $\text{C}_8\text{H}_9\text{O}_2$ , the formula of which must probably be doubled, as oxidation changes it into diphtalic acid.

A. BAEYER, "*Regularity in the Melting-points of Homologous Compounds*." The author detects in the melting-points of the normal acids of the oxalic series a peculiar regularity, those containing an unequal number of C atoms melting always lower than those containing an equal number; thus—

$\text{C}_4\text{H}_6\text{O}_4$ .. ..	180°	$\text{C}_5\text{H}_8\text{O}_4$ .. ..	97°
$\text{C}_6\text{H}_{10}\text{O}_4$ .. ..	148°	$\text{C}_7\text{H}_{12}\text{O}_4$ .. ..	103°
$\text{C}_8\text{H}_{14}\text{O}_4$ .. ..	140°	$\text{C}_9\text{H}_{16}\text{O}_4$ .. ..	106°
$\text{C}_{10}\text{H}_{18}\text{O}_4$ .. ..	127°	$\text{C}_{11}\text{H}_{20}\text{O}_4$ .. ..	108°

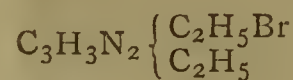
It is also noticeable that in the one series the melting-point ascends, while in the other it descends. A similar regularity, although with ascending melting-points in both series, is to be noticed in the normal fatty acids.

"*Derivatives and Constitution of Furfurol*." By treatment with HI and amorphous phosphorus furonic acid yielded hydro-furonic acid,  $\text{C}_7\text{H}_{10}\text{O}_5$ , and the  $\alpha$ -pimelic acid,  $\text{C}_7\text{H}_{12}\text{O}_4$ , of Dale and Schorlemmer. The author then brings together the evidence in proof of the presence of the chain-formed group,  $\text{C}_4\text{H}_4\text{O}$ , in furfurol.

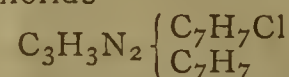
A. BAEYER and P. TÖNNIES, "*Furfur-angelic Acid and Furfur-butylen*." It is found that Perkin's reaction for the condensation of aromatic aldehyds with acetic anhydride can be used also with furfurol. Sodium butyrate, butyric anhydride, and furfurol yield on heating furfur-angelic acid,  $\text{C}_4\text{H}_3\text{O}.\text{CH}=\text{CHCH}_2\text{CH}_2\text{CO}_2\text{H}$ , which sodium amalgam reduces to normal furfur-valerianic acid. Iso-butyrate of potassium and isobutyric anhydride act, however, quite differently with furfurol. At a low temperature  $\text{CO}_2$  is driven off, and the reaction leads to the formation of furfur-butylen,  $\text{C}_4\text{H}_3\text{OCH}=\text{CHCH}_2\text{CH}_3$ , a colourless oil, boiling at 153°.

G. WYSS, "*On Glyoxalin*." The preparation from aldehyd is described. As acetyl chloride and benzoyl

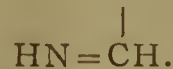
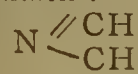
chloride form no compounds with glyoxalin, it seemed to be a tertiary base. Other reactions would seem to prove the presence of the group NH. With ethyl bromide it formed the base—



and with benzyl chloride—



Bromine changes it into tribromo-glyoxalin,  $\text{C}_3\text{HBr}_3\text{N}_2$ , which possesses acid properties, and shares with prussic acid the distinction of being the only organic acids containing neither oxygen nor sulphur. It forms white insoluble salts with the heavy metals, and the silver-salt gives ethers with  $\text{CH}_3\text{I}$  and  $\text{C}_2\text{H}_5\text{I}$ , which crystallise well. By the action of sodium amalgam on these ethers methyl- and ethyl-glyoxalin are obtained in the form of colourless oils. Silver nitrate forms, in a solution of glyoxalin,  $\text{C}_3\text{H}_3\text{AgN}_2$ , which yields also the ethers with the above-mentioned iodides. These reactions lead to the adoption of the following formula for glyoxalin:—



E. SCHMIDT, "*Polysulphydrates of Brucine*." The two derivatives formerly prepared by the author have been analysed by Hofmann's method, and found to possess the formulæ  $(\text{C}_{23}\text{H}_{26}\text{N}_2\text{O}_4)_3(\text{H}_2\text{S}_6)_2$  for the red compound, and  $(\text{C}_{23}\text{H}_{26}\text{N}_2\text{O}_4)_3\text{H}_2\text{S}_6$  for the yellow compound.

V. MEYER finds that "*Triethyl-benzyl Ammonium Iodide*" does not pass over into a triethylamine by distillation with HI, as asserted by Ladenburg.

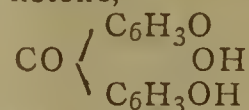
A. FLEISCHER and W. HANKO find the "*Distillation Products of the Xanthates*" to be  $\text{CS}_2$ ,  $(\text{C}_2\text{H}_5)_2\text{S}$ ,  $(\text{C}_2\text{H}_5)_2\text{S}_2$ , and  $\text{COS}$ , or  $\text{C}_2\text{H}_6\text{S}$ ,  $\text{CS}_2$ ,  $\text{C}_2\text{H}_6\text{O}$ ,  $(\text{C}_2\text{H}_5)_2\text{S}$ ,  $(\text{C}_2\text{H}_5)_2\text{S}_2$ ,  $\text{CO}_2$ , and  $\text{SH}_2$ , according as the anhydrous or crystalline salts are used.

A. FLEISCHER and G. NEMES have examined the "*Action of Nitric Acid upon Carbanilide*," and found the result to be tetra-nitro-diphenyl urea.

A. SCHULLER and V. WARTHA, "*Calorimetric Investigations*." The authors describe a slightly modified form of Bunsen's calorimeter adapted for the determination of the heat of combustion, and experiments on the combustion of H and O. The heat developed by the combustion of 1 grm. of H to  $\text{H}_2\text{O}$  is 34,126 grm. calories, slightly higher than observed by Andrews and by Thomson.

A. CLAUS and H. GRAEFF, "*Action of Sodium Amalgam on  $\alpha$ -Nitro-naphthalen-sulphonic Acid*." Instead of yielding an azo-naphthylen, as expected, this reaction causes a decomposition into naphthylamin and  $\text{H}_2\text{SO}_4$ . The nitro-benzene-sulphonic acids are, however, easily changed into the corresponding azo-compounds by this reaction.

A. CLAUS and H. ANDRÆ have obtained, by the "*Action of Oxalic Acid on Resorcin at a High Temperature*," a di-resorcin ketone,—



O. N. WITT, "*Action of Primary Amines on Diphenyl-nitrosamine*." The reaction, which is quite violent, produces, in the case of aniline, diazo-amido-benzene, amido-azo-benzene, diphenylamin, and small quantities of a new substance crystallising in ruby-red needles. It receives the formula  $\text{C}_6\text{H}_5.\text{N.N}.\text{C}_6\text{H}_4.\text{N}[\text{N}(\text{C}_6\text{H}_5)_2]_2$ , is regarded as the first representative of a new class of bodies, the tri-azo-compounds, and is obtained in larger quantities by heating amido-azo-benzene, diphenylamin, and aniline at 125°.

R. GNEHM and G. WYSS, "*Nitro-Derivatives of Diphenylamin*." Diphenylamin, methyl-diphenylamin, and diphenyl-nitrosamine all yield—by treatment with  $\text{HNO}_3$  in an acetic acid solution—tetra-nitro-diphenylamin,  $\text{HN}[\text{C}_6\text{H}_3(\text{NO}_2)_2]_2$ . It crystallises in yellow needles, forms brilliant scarlet solutions with alkalis, and imparts

directly to wool and silk a fine yellow tint. The insoluble character of the compound prevents its application as a dye. Reduction yields an extremely unstable base, probably tetramide-diphenylamin. Tetra-bromo-diphenylamin is changed by the action of  $\text{HNO}_3$  into dinitro-tribromo-diphenylamin,  $\text{NC}_{12}\text{H}_6(\text{NO}_2)_2\text{Br}_3$ .

O. HESSE, "On some Lichen Colouring-Matters." The author shows that the acid previously obtained by him from *Usnea barbata* is carbonusnic acid, in opposition to the statements of Paterno. He has further detected in its company small quantities of a new acid,  $\text{C}_9\text{H}_{10}\text{O}_3$ , which receives the name usnetic acid.

F. C. G. MÜLLER details several experiments in proof of the theory that the "Temperature of the Aqueous Vapour escaping from Boiling Saline Solutions" is but  $100^\circ$  at the moment of the formation of the vapour, and rises afterward by conduction, as in ordinary cases of superheated steam.

E. FISCHER, "Aromatic Hydrazin Compounds." A number of reactions with phenyl-hydrazin are described. Furfurol unites with it, under separation of a molecule of water. With cyanogen gas a base,  $\text{C}_6\text{H}_5\cdot\text{N}_2\text{H}_3(\text{CN})_2$ , is obtained. Heating with sulphur decomposes the compound chiefly to aniline. With diazo-benzene it yields diazo-benzene-imide, which is also formed by the action of I on the emulsion in water. By heating with  $\text{K}_2\text{S}_2\text{O}_7$  potassium phenyl-hydrazin-sulphonate is obtained, which is easily oxidised to potassium diazo-sulphonate. From the various connections with diazo-benzene the author regards the formula  $\text{C}_6\text{H}_5\cdot\text{NH}\cdot\text{NH}_2$  for phenyl-hydrazin as placed beyond doubt.

C. REISCHAUER, "On the Formation of Mycoderma." A number of observations and analytical experiments on the influence of *Mycoderma* on beer are recorded, and accompanied by analyses of various beers.

J. THOMSEN finds that "Baric Iodide," when crystallised under normal circumstances, contains  $7\text{H}_2\text{O}$ , and regards the formation of a salt with  $2\text{H}_2\text{O}$ —as given by Werther—as problematical.

K. HEUMANN has prepared, by the "Action of Alkaline Haloid Compounds on Silver Ultramarine," blue and green ultramarines, containing K, Na, Li, &c., in the place of silver.

P. CLAESSON, "Action of KNSC on Derivatives of Mono-chlor-acetic Acid." Sulpho-cyan-acetic acid is prepared by the action of KNSC on the aqueous solution of sodium mono-chlor-acetate, in the form of a colourless, odourless oil. Various salts and ethers are described. The salts yield, upon treatment with HCl, carbamine-thioglycollic acid, easily decomposed by salts having an affinity for sulphur. By the action of mono-chlor-acetic acid on sulpho-carbamide, as well as by the action of HCl on the ether of sulpho-cyan-acetic acid, the author obtains an acetic mustard-oil,  $\text{H}\cdot\text{O}\cdot\text{COCH}_2\text{NCS}$ , crystallising in colourless laminæ and possessing weak acid properties.

P. JANNASCH prepares "Para-xylol from Dibrom-benzene" in quantities, by treatment with Na and  $\text{CH}_3\text{I}$ .

The Society adjourns until October 15th.

**The Miraculous Pen.**—We have received from Messrs. Mawson and Swan samples of a new pen which will, we think, serve a useful purpose. It is called "The Miraculous Pen," for writing without ink. It is used like an ordinary pen, but dipped into water instead of into ink. The ink which this pen generates instantaneously is always limpid, dries rapidly, and remains fixed and unalterable on the paper, and the writing obtained with it may be copied by the press. The chemical composition which is fixed to it is said to be concentrated to such a degree that each pen in ordinary use lasts at least several months. These pens are prepared with different colours, such as dark purple, red, dark blue, black, &c., and to write in these various colours a single little glass of water in the office is sufficient.

## NOTICES OF BOOKS.

*Chemical Composition of Foods, Waters, Soils, Minerals, Manures, and Miscellaneous Substances.* Compiled by E. T. KENSINGTON, F.C.S. London: J. and A. Churchill.

THIS work contains a considerable quantity of information, useful, and at the same time somewhat difficult to procure. Not merely the outside public, but professional chemists, if suddenly asked what is the average composition of such or such a body, are at a loss where to look for an immediate answer. Mr. Kensington's compilation therefore supplies a want which must have been often felt. If we point out certain defects which in our opinion somewhat interfere with the value of the book, we are actuated not by a desire to find fault, but by the wish that future editions may be rendered still more serviceable to the public. Thus it would be an improvement, in our opinion, if each analysis showed its authority and its date. A more particular description of the origin and nature of the article analysed would in certain cases be very useful. Thus, on p. 100, we find "Manure, detailed composition," but whether it is stable manure or general farm-yard manure, and what is its condition, we do not learn. On turning to p. 103, however, we find another less detailed analysis of "Manure, mixed long fresh dung in natural state." On comparing the figures we find that the two samples are identical.

An analysis of cockchafers, placed rather oddly in an Appendix otherwise devoted to articles of food, makes no mention of chitin, but gives 16.06 per cent of "fibre."

In the analyses of wines "absolute alcohol" and "proof-spirit" are given as if they were two distinct and co-existent constituents. This will not mislead chemists, but is very likely to puzzle the general public. It is surely time that the term "proof-spirit," utterly arbitrary and incomprehensible to half the world, should be discarded in stating the composition of wines, malt liquors, &c.

In an analysis of soda-waste—which by the way shows none of the valuable fertilising constituents a certain inventor has been pleased to find in this refuse—we see the item "Silicate of manganese, 6.91 per cent." This is utterly incomprehensible save on the supposition that the author meant to say silicate of magnesia. In a sherry from the "Pure Wine Association" we find the total solids given as 3.47 per cent; yet the grape-sugar alone is stated as 3.26 and the tartaric acid at 0.33, thus already exceeding the total of solid matters.

An analysis of "Russian salt produced by the freezing process" is very interesting. As obtained at Oustkout it contains—

Chloride of sodium .. ..	74.84
„ of aluminium .. ..	1.17
„ of calcium .. ..	5.21
„ of magnesium .. ..	3.57
Sulphate of soda .. ..	15.21
	<hr/>
	100.00

We have no desire to make what a certain chemist calls a "dietetic examination" of such an article.

In a second section of manures—which might have been more conveniently placed along with the former group (pp. 94 to 106)—we meet with a "Liquid Manure," possibly the drainage of a cesspool or a heap of farm-yard manure; but its exact nature and origin ought to have been mentioned. Not far off we come upon the analysis of a wheat-manure, likewise of unknown origin. We can hardly consider it as a model showing what a wheat-manure ought to be, since it contains common salt to the extent of 16.84 per cent. If salt is needed the farmer can certainly add it to his soils at a lower figure than the price of any wheat-manure in the market.

On the same page figures the analysis of a "British Economical Manure":—

Moisture .. .. .	9.86
Green vitriol .. .. .	28.81
Sulphate of lime .. .. .	2.05
Common salt .. .. .	13.39
Bisulphate of soda .. .. .	30.69
Sand .. .. .	15.20

100.00

Nitrogen .. .. 0.06.

Such an article must be much more economical to the seller than to the consumer. In a sample bearing the same name, which once fell into our hands, we found sulphates of copper, zinc, and lead,—in short, a medley such as might be formed from the refuse of ill-managed chemical works.

We hope that in future editions the author will see his way to the removal of such flaws as we have felt it our duty to point out.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 1, July 2, 1877.

**Researches on Anhydrous Chloral and on its Hydrate.**—M. Berthelot.—Experiment shows that heat is liberated in the reaction of gaseous chloral upon gaseous water, with formation of a gaseous compound. Hence a gaseous chloral hydrate really exists as distinct from a mere mixture of the two vapours. This conclusion agrees with the results obtained by M. Troost from the study of the tensions of dissociation. It is supported by the fact that anhydrous chloral in vapour does not combine instantaneously with water, but condenses in it at first in the form of an oil which only dissolves gradually even on agitation; whilst the vapour of chloral hydrate, on the contrary, condenses under water in the state of crystalline hydrate, except agitated.

**Researches on the Compressibility of Liquids.**—M. E. H. Amagat.—The liquids examined are ethers, alcohols, benzol, acetone, chloroform, and bisulphide of carbon. The results are given in the form of a table.

**Vapour of Chloral Hydrate.**—M. L. Troost.—The author's former results on the volume-equivalent of chloral hydrate having been called in question by M. Wurtz, he has repeated his experiments, and arrives at the same conclusion given in his former paper (lxxxiv., p. 711) in which the volume-equivalent in question is stated = 8.

**Dissociation of Hydriodic Acid in Presence of an Excess of One of its Elements.**—M. G. Lemoine.—The author calls attention to the stability which an excess of one of its elements gives to the compound. On mixing hydriodic acid with increasing quantities of hydrogen the proportion of the acid which is dissociated is diminished by about the half.

**Dissociation of Ammoniacal Salts in Presence of Metallic Sulphides.**—P. de Clermont and H. Guiof.—The chloride and sulphate of ammonium, as well as the salts of organic acids, are dissociated when heated along with the sulphides of manganese, silver, and probably of other metals. This fact explains the difficulty encountered in the determining manganese with ammonium sulphide in presence of ammoniacal salts, as observed by Terreil, Spiller, How, and Claessen. The ammoniacal salt dissolves the manganese sulphide in the cold without decomposing it. On the application of heat the acid liberated in consequence of the dissociation of the ammoniacal salt decomposes a certain quantity of the manganese sulphide,

forming a soluble manganese salt, which is only precipitated on adding a fresh dose of ammonium sulphide.

**Use of Boron Fluoride as a Dehydrating Agent.**—M. F. Landolph.—The author describes the behaviour of the reagent in question with camphor anethol, benzylic aldehyd, chloral, and ethylen.

**Ordinary Presence of Copper and Zinc in the Human System.**—F. Raoult and H. Breton.—The authors consider that the presence of these metals in the bodies of animals has been admitted by toxicologists for some time.

**Ponderable Determination of Ozone in the Atmosphere.**—M. Albert Levy.—The author's determinations are founded on the conversion of sodium arsenite and free arsenious acid respectively into sodium arseniate and arsenic acid. He finds that the platinum, which in his apparatus comes in contact with the liquid, has no disturbing influence.

*Bulletin de la Société d'Encouragement pour l'Industrie Nationale.* July, 1877.

**Manufacture of Eburine.**—M. Latry (a report presented by MM. Cloëz and Davanne on behalf of the Committees of the Chemical Arts and the Fine Arts as applied to Industry).—Eburine is a composition formed from the dust of ivory or bone cemented together with gum tragacanth or albumen, and coloured at pleasure. In some cases pressure and heat render the addition of any glutinous matter unnecessary.

**Preparation of Celluloid.**—Paper is treated by a continuous process with 5 parts of sulphuric acid and 2 of nitric acid, which convert it into a sort of gun-cotton. The excess of acid is removed by pressure, followed up by washing with abundance of water. The paste when thus washed, drained, and partially dried, is ground in a mill, mixed with camphor, ground again, strongly pressed, dried under a hydraulic press between leaves of blotting-paper, cut, bruised, laminated, and compressed again in a special apparatus suitably heated. It is said to be hard, tough, transparent, elastic, fusible, becoming plastic and malleable at 125°. It ignites with difficulty, is decomposed suddenly at 140° without inflammation, and gives rise to reddish fumes. It is inodorous, and does not become electric on friction.—*Bull. de la Soc. Industrielle de Rouen.*

*Les Mondes, Revue Hebdomadaire des Sciences,* No. 11, July 14, 1877.

**On the Non-poisonous Properties of Magenta and of Wines coloured therewith.**—Dr. Bouchut.—The author considers that magenta, in small doses at least, is not poisonous, but holds that its use in the manufacture of spurious wines is still a punishable fraud.

## NOTES AND QUERIES.

**Petroleum.**—Will some reader oblige by indicating the best source of information upon the commercial valuation and preparation for market of crude petroleum and paraffins? An English work preferred.—HYDROCARBON.

**Commercial Sulphuric Acid.**—Referring to Mr. W. M. Watts's letter in the last number of the CHEMICAL NEWS (vol. xxxvi., p. 42), I beg to say that our firm, the Melincrythan Chemical Company, Neath, will be happy to supply him with any quantity of sulphuric acid perfectly free from arsenic at 1d. per pound in carboys here.—HENRY B. GIBBINS.

**Commercial Sulphuric Acid.**—I should recommend your correspondent, Mr. W. M. Watts, to use sulphuric acid made from spent oxide, which I have found very free from arsenic. It rivals sulphuric acid in appearance, the only impurity being a trace of iron, which will not interfere with his boys' experiments, and it may be obtained for little more than a penny per pound. The nearest place that I know of where it may be got is Messrs. Spence, Bros., Bradford, Manchester.—J. NAPIER, Bramford, Ipswich.

# THE CHEMICAL NEWS.

VOL. XXXVI. No. 924.

## ON REPULSION RESULTING FROM RADIATION.—PART IV.\*

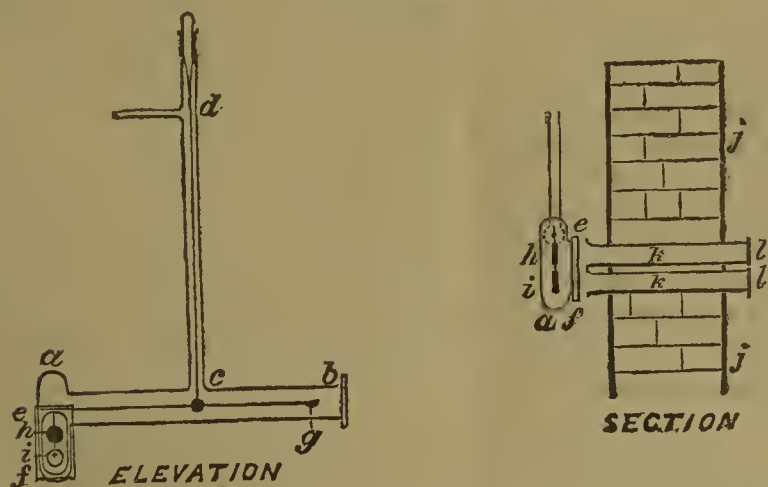
By WILLIAM CROOKES, F.R.S., &c.

(Continued from p. 47.)

198. I HAVE hitherto taken it for granted that a lamp-black surface is the most repelled by radiation, and that a white surface, such as that of freshly cut pith, is the least repelled. Experiments tried repeatedly with other surfaces abundantly confirm this supposition. It was necessary, however, to get accurate data on this point; and I have accordingly fitted up an apparatus which will enable me to measure the force of radiation and its action on disks of various materials of the same size, compared with a standard black disk.

The apparatus is represented in fig. 16. It is similar in principle to the torsion-apparatus already described (186). *ab* is the horizontal tube containing the glass torsion-beam; *cd* is the suspending fibre, also of glass. In the centre of the beam is a mirror, from which an index ray of light is reflected. The end *a* of the horizontal tube is sealed on to a wider piece of tube in a vertical position, and having in front of it a large opening (*ef*) occupying the whole of one side of the piece of tube; this opening has the edges ground perfectly flat, and is closed with a piece of plate glass cemented on. The object of the opening is to enable the disks to be changed. At the end (*b*) of the horizontal tube is another opening, closed in like manner with a plate of glass. This is to give access to the pan (*g*) of the beam, so as to counterpoise the disks, as they are not all of the same weight. At the other end of the beam a light aluminium bar hangs, on which is cemented the standard disk *h* and the movable disk *i*. The standard disk is of pith, coated with lampblack by holding it over the flame of burning turpentine. The movable disk may be of any substance.

FIG. 16.



The apparatus was fitted up in a recess built of brick, and closed in front with a glass window. In the brick wall at the side *j* holes were pierced opposite the disks and the central mirror. These were lined with card tubes (*k*) blacked inside. The interstices were packed with cotton-wool, and the apparatus was closely surrounded with Winchester quart-bottles filled with water. In front of the card tubes wooden shutters (*l*) were fastened, so that either one could be opened independently of the other. The apparatus was sealed on to the pump by

\* A Paper communicated to the Royal Society, February 5, 1876 From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

means of the arm shown at the upper part of the torsion-apparatus.

With nothing in the pan, and only the standard black disk on, the beam is in equilibrium; consequently each new disk requires a special counterpoise.

199. The following weights and measurements of the different parts of the apparatus were taken:—

Weight of glass beam, central stirrup, and mirror..	3.0485 grains.
Standard black disk and aluminium bar..	0.4635 grain.
Pan at other end of glass beam, acting as counterpoise for above ..	0.5263 „
Weight of white pith disk and support ..	0.2670 „
Counterpoise for ditto..	0.3085 „
Length of arm from centre of support to centre of disk ..	99 millims.
Length of arm from centre of support to centre of counterpoising pan..	84 „
Diameter of disks ..	17.25 „
Torsion of suspending fibre, in air, with glass rod (186) hanging to it..	15.75 seconds.

200. The experiments were tried as follows:—The exhaustion having been carried to the utmost point, so that no increase in sensitiveness was produced by further working the pump, a standard candle was adjusted opposite the black disk and at a definite number of millimetres off. The deflection of the index ray of light was then taken on opening the shutter. After completing this observation, the beam was allowed to come to rest; the candle was then lowered till it was opposite the lower disk, and the deflection caused by it was again taken. These were repeated several times. The mean results of the first series are given in the following Table (the lower disk being plain white pith):—

Distance of candle from disks.	Screen interposed.	Deflection of index ray of light on millimetre-scale 1100 millims. from mirror.			
		Black disk.	White disk.	Reduced to Black = 100.	
				Black.	White.
800	Nothing ..	192	32	100	16.7
900	„ ..	122	21	100	17.1
1200	„ ..	62	10	100	16.1
500	Cell of water ..	80	7	100	8.7
500	Alum plate ..	100	8	100	8.0
500	„ solution ..	76	7	100	9.2
500	Ammonia gas, 6 ins. thick, and cell of water ..	79	7	100	8.8
800	Ammonia gas alone	190	31	100	16.3

201. The lower disk was removed and replaced by a disk of pith thickly coated on one side with pure precipitated carbonate of lead. The disk weighed 0.499 grain, the counterpoise weighing 0.530 grain.

After complete exhaustion, the results of various experiments are shown in the following Table:—

Distance of candle from disks.	Screen interposed.	Deflection of index ray of light on millimetre-scale 1100 millims. from mirror.			
		Black.	Carb. Lead.	Reduced to Black = 100.	
				Black.	Carb. Lead.
800	Nothing ..	130	17	100	13.0
500	Iodine in disulphide of carbon ..	127	9.5	100	7.5

Instead, therefore, of carbonate of lead being a good absorber of the rays which produce motion, it is a better reflector than a plain white pith surface, owing probably to its superior whiteness.

202. Another black surface was now sought for to com-

pare with the standard disk. Pith coated with precipitated iodide of palladium was employed. The disk weighed 0.460 grain, and the counterpoise 0.491 grain. The results were:—

Standard Black.	Iodide of Palladium.	Reduced to Black = 100.	
		Black.	Iodide of Palladium.
70	61	100	87.3

203. Plates of alum and of rock-salt were successively introduced into the apparatus, to be compared with the standard black disk. The apparatus was, however, not sufficiently sensitive to enable me to make satisfactory comparisons. The average of several observations (which, however, were not so concordant as I should have liked) were—

Standard Black.	Rock-salt.	Reduced to Black = 100.	
		Black.	Rock-salt.
131	4	100	3

Standard Black.	Alum.	Reduced to Black = 100.	
		Black.	Alum.
120	6	100	5

There was no action on either the alum or the rock-salt when a screen of water or of alum was interposed.

204. In consequence of some experiments tried by Professors Tait and Dewar, and published in *Nature*, July 15th, 1875, I fitted up a more sensitive apparatus for the purpose of carefully examining the action of radiation on alum, rock-salt, and glass. The apparatus was similar to the one described in par 186, there being, however, no window at either end. To the horizontal beam suspended by the glass fibre were attached a plate of alum at one end and a plate of rock-salt at the other. Each plate was perfectly polished and transparent, and measured 12.5 by 13.5 millims., and was 1.5 millim. thick. The deflection was produced by a candle placed opposite the crystalline plate under examination, and it was measured in the usual way by a reflected ray of light. The following were the results:—

Distance of candle from plate.	Deflection observed.		Reduced to alum = 100.	
	Alum.	Rock-salt.	Alum.	Rock-salt.
150 millims. ..	21	17	100	81
" " ..	22	17	100	77.3
" " ..	24	17	100	71
100 " ..	48	30	100	62.5
" " ..	43	26	100	60.4

The action on the alum was found to increase at each observation. A glance at the plate showed the reason. When it was first put in it was perfectly smooth and transparent. Before it had been long in the vacuum efflorescence commenced, and when the first observation was taken the surface of the alum plate was dotted over with small white specks, which increased in size and number as the experiments were continued. The opacity thus caused was apparently sufficient to account for the increased action of radiation upon the alum plate.

The pump was kept going the whole time, so that the water vapour evolved from the dehydrating alum might be carried away and prevented from interfering with the results, as it otherwise would have done (130). The last two experiments, however, show the effect of aqueous vapour.

205. To test the accuracy of the explanation that the opacity caused increased action, I coated two disks of pith, one with powdered rock-salt and the other with powdered alum, and tested them against lampblack pith in a similar apparatus to the one described in par. 198. The deflections were—

Black pith.	Powdered alum.	Powdered rock-salt.
110	38	18
or reduced, 100	34.5	16.3

As will be seen on reference to par. 203, the ratio between the black disk and the plate of rock-salt was 100 : 3. Powdering the rock-salt has therefore increased the action 13.3 per cent. The much larger action of the powdered alum is probably due to the fact that crushing the crystals facilitates efflorescence *in vacuo*.

206. The alum and rock-salt plates were removed, a fresh alum plate ground and polished, and this and the rock-salt were coated with lampblack. They were then put into the apparatus as before, the black side being away from the source of radiation, so that the rays would have to pass through the crystal plates before meeting with the lampblack. The deflections were taken as soon as the vacuum was good. The deflections were—

Blackened alum.	Blackened rock-salt.
26	19
or reduced, 100	73

The rock-salt was more slow in its movements under the influence of radiation than the alum was, but they both return to zero equally well.

207. A very sensitive apparatus, similar to the torsion-apparatus described in par. 198, fig. 5, was now employed, and a clear polished disk of rock-salt and a thin disk of glass of the same size were placed therein. The apparatus was very well exhausted, and the deflections taken when the radiation from a candle was allowed to fall on either disk. The mean of several concordant observations was—

Rock-salt.	Glass.
39	40

I quote the following from the article in *Nature* already referred to:—"Prof. Dewar then proceeded to show that the heating of the disk was the efficient cause of the action. Two equal disks, one of rock-salt, the other of glass, were attached to the glass fibre. The rock-salt was inactive when the beam [from a candle] was thrown on it; the glass disk was active. The reason is evidently that the rock-salt is not heated, being transparent to heat, whereas the glass is opaque, absorbs the heat and is heated." It will be seen that I have failed to obtain this marked difference in action between rock-salt and glass, although the glass shell of the apparatus was as thin as was consistent with strength to resist the atmospheric pressure.

208. The action of radiation on surfaces of pith coated with thin layers of different substances is deserving of considerable attention. I have had an apparatus at work for several months past, in which six disks can be experimented with on the same beam and during the same exhaustion (similar to the arrangement described in par. 198, which held two disks). With this I have tried many hundred experiments, using the flame of a candle direct, or shaded by screens of water, alum, &c. The results are of much value, as showing that there is no definite connexion between the colour of a body and the mechanical action of radiation upon it. For instance, taking the movement of the lampblack pith, under the influence of a standard candle, as 100°, I find that under the same conditions

Precipitated silver .. .. .	moves 56°
Amorphous phosphorus .. .. .	" 40
Sulphate of baryta .. .. .	" 37
Red oxide of iron .. .. .	" 28
Scarlet iodide of mercury and copper .. .. .	" 22
Lampblack silver .. .. .	" 18
White pith .. .. .	" 18
Rock-salt .. .. .	" 6.5
Glass .. .. .	" 6.5

These are only a few of the results I have obtained. The experiments will occupy some time to carry out with the completeness which they deserve, and I therefore propose to defer any further mention of them to a subsequent paper.

(To be continued.)

ON  
SOME SIMPLE LABORATORY MANIPULATIONS.

By Dr. P. TOWNSEND AUSTEN.

II.

*Washing out Flasks by Inversion.\**

To wash a precipitate out of a flask would seem to be an easy manipulation, but yet the extraction of the last particles is often a tedious operation. This is particularly true in the case of small grains of sand or mica in the analysis of silicates, as well as with heavy gelatinous precipitates.

By using the following simple method a flask may be washed out at a single operation.

1. The flask contains a hot liquid.—The flask, which ought for the sake of convenience to be half full, is suddenly inverted† in a dish, the larger the better, containing about as much liquid as in the flask. This operation requires a little skill. It is most easily performed by holding the mouth of the flask over the rim of the dish, then gradually inverting the flask, and, as soon as the liquid begins to flow out, suddenly inserting it, putting the mouth of the flask entirely under the surface of the liquid, and at the same instant bringing it by a swift movement to the middle of the dish. After a few seconds the cooling of the air in the flask occasions a partial vacuum, and the liquid rises in the flask. If the liquid has been at a boiling temperature the flask will be almost filled. After allowing the liquid to ascend the flask is firmly held by the neck with one hand,‡ while the other grasps the bulge. By gently shaking the flask the liquid slaps against the top (bottom) and sides, thus dislodging completely all adhering particles. A slight revolving motion

is then given, and the heavy solid particles go quickly down through the neck of the flask into the dish. After all the substance has been removed the flask is gradually tilted and the liquid allowed to run out. This operation also requires a little skill. If a bent glass tube be introduced into the flask, a quick exit of the contained liquid is effected. Care must be taken that the dish holds easily the additional amount of liquid contained in the flask, and that the liquid in the dish is warm.

2. The liquid in the flask is cold.—The flask is inverted in the manner described. A bent tube is introduced into the flask and the air partly drawn out. The operation is then conducted as in the other case.||

After this treatment it will be found that the flask is completely free from all adhering particles.

*Crystallisation by Gradual Dilution.*

It became necessary for me, not long since, to obtain some perfect crystals of a substance with which I was working, and I experienced considerable difficulty in obtaining solvents which would yield me the desired results.

The fact of argol being deposited by the gradual dilution of alcohol, wherein it is insoluble, struck me as afford-

\* This method is not very applicable, however, to liquids holding light powders in suspension. By standing as in the silver assay and allowing the substance to settle, agitating occasionally to prevent its deposition on the bulge of the flask, even suspended powders may be removed.

† I much prefer this to corking the flask, inverting, and then removing the cork.

‡ Protected by a felt pad if necessary.

|| It often occurs in analytical operations that the increase of volume in the liquid is not desirable. Excellent results may be obtained by rapid inversion of the flask in an empty dish. As soon as enough of the liquid has escaped to cover the mouth of the flask, the settling of the precipitate begins. The admission of air bubbles caused by the cooling of the liquid does no harm.

ing a clue to the right manner of crystallising in general, and of this case in particular.

I dissolved the substance (dinitro-brom-benzol) in boiling glacial acetic acid, allowed the solution to cool to about 70°, and then added an equal volume of absolute alcohol, at a temperature of about 50°, stirring all the time. If the substance showed signs of separating prematurely a little more acetic acid was added. The mixture was then allowed to stand in a warm place. The crystallisation soon began. The formation of acetic ether\* keeps pace with the separation of the crystals, so that as the substance is withdrawn from the solution, the water resulting from the formation of the ether dilutes the solution, thus keeping up a continuous separation. The ether may be allowed to evaporate, so that finally a very dilute acetic acid solution, containing but little of the substance, is left behind. I have tried this method with various substances and have been rewarded by beautifully formed crystals. I have noticed that many of the crystals obtained in this manner were remarkably transparent. The only requisites are naturally that the substance to be crystallised must be soluble in acetic acid, alcohol, and acetic ether, and insoluble in water.

It is often necessary to allow solutions to cool off very slowly. For this purpose I find the cork box, to which attention has so often been drawn, to be most admirable. The cork should be about an inch in thickness and covered with the pads of felt previously mentioned. If the liquid is to be kept from the air or from motes, or other nuclei forming specks of matter, it should be boiled in a beaker, or glass vessel, having a ground rim, and while boiling quickly covered with a ground-glass plate. A brush dipped in a solution of pure rubber in chloroform is run around the line of jointure of the two surfaces. This forms a connecting film impervious to both air and moisture.



I shall conclude this paper by drawing attention to a useful little instrument which has lately appeared. Its manner of action can at once be understood from the subjoined cut.

For cleaning flasks and tall beakers, wherein the hand cannot be introduced, it will be found extremely serviceable. A ball of wet newspaper grasped in the claws will be found excellent in cleaning beakers. A small towel or rag can be manipulated by means of it, with great effect on the inside of the flask. It is well to have several bent at right angles for cleaning flasks. It can also be used for pulling corks.

New York School of Mines,  
April 10, 1877.

NOTE ON  
ALKALINE CHLORIDES FOUND ON VESUVIUS.

By WATSON SMITH, F.C.S.

ON descending a short distance inside the active crater, a fissure was observed which appeared to be partially filled with a hard white mass of some salt. This salt was so extremely hot, and at the same time so hard, that it was a matter of considerable difficulty to break off enough for a sample. There appeared to be from 8 lbs. to 10 lbs. weight of the salt in the fissure, and it had evidently been in a fused condition, afterwards hardening on cooling to some extent. An analysis of the salt gave the following results:—

	Per cent.
Potassium chloride .. ..	67.13
Sodium chloride .. ..	31.01
Potassium sulphate .. ..	1.86



ON SOME METHODS OF ESTIMATING  
TANNINS.\*

By H. R. PROCTER, F.C.S.

THERE are few substances of equal importance to the tannins, of which the chemistry is in so unsettled a state. This is, no doubt, primarily due to their complexity and unstable character, which makes their investigation one of great difficulty; and, secondarily, to the indifference and ignorance of chemistry of those to whom the knowledge is of commercial importance. But tanners may be well excused for some distrust of chemical analyses when we consider the discordant results which are yielded by most of the processes in use. With a view to exhibit the relative merits of these processes, I have ventured to give the results of comparative experiments undertaken to test their accuracy, and to point out, if possible, those which merit confidence.

The process which has been brought most prominently before the public of late is that of Müntz and Ramspacher, which consists in forcing a tannin infusion through a piece of raw hide, taking the sp. gr. before and after, and calculating the tannin from the loss. In a paper which I communicated to this Society some little time since (*Proceedings*, iii., 213) I pointed out that the raw hide not only absorbed the tannin, but also a large proportion of the free acids in the infusion, thus, in some cases, causing a notable error. To this I may now add that it is extremely difficult to absorb the whole of the tannin, that the first portion of liquor which passes is invariably lighter than succeeding portions, and that the sources of error are so large in proportion to the quantities to be measured that the results are of little practical value. In proof of this I may mention that a series of nine analyses of the same sumach, well mixed, and kept in a tightly-corked bottle, gave results varying from 18 to 28 per cent, and a mean error for each single experiment of 3.15 per cent, or upwards of 13 per cent of the total tannin, while the mean value—23.9 per cent—was probably itself too high. In these analyses the utmost care was taken, and in each case the absence of tannin in the filtrate was proved by gelatin. If we assume that tannin is worth 20s. per ton per cent, which is not far from the truth, the chemical valuation of this sumach would vary from £18 to £28 per ton, with an average error of £3 3s., and obviously is far more erroneous than the merest guess. If any further proof of the inaccuracy of the method is needed, I may quote the results of a series of twelve analyses of a valonia by Mr. W. N. Evans, who, perhaps, has had more practice with the tan-tester than any other man in England. The average error exceeds 10 per cent of the whole quantity of tannin, and the money values vary from, say, £17 5s. to £28 10s. per ton.

The older method of Hammer, in which absorption by hide-raspings takes the place of the raw hide-filter, is in my experience still more inaccurate; and I cannot say that the slight modifications proposed by Nickerson are any improvement.

Another method which has long been in use is precipitation by volumetric solution of gelatin and alum. With a solution of 5 grms. of gelatin per litre I found it impossible to say whether tannin or gelatin was in excess, with less differences than about 4 per cent of the total quantity employed, and then the reactions were somewhat doubtful. These experiments were made with pure tannin; with catechu or gambier the uncertainty would be far wider, and with used tan-liquors it would be worse still. Under favourable circumstances and with great patience it is possible to obtain rough estimates by this method; but this is all I can say.

Concerning Sir H. Davy's still older method of precipitating with gelatin, filtering, drying, and weighing, and

reckoning four-tenths of the whole as pure tannin, Dr. J. Watts says (*Pharm. Journ.*, viii., 517) it has "been shown to be both tedious and incorrect, as the solution refuses to filter, and the first portions precipitated contain a far larger proportion of tannin than do those which fall towards the end." Other chemists make the same statements, so that I had not thought it necessary to repeat their experiments. Very recently, however, I have learnt that Mr. Stoddart, of Bristol, and Mr. Dearden, of Bury, are again employing the plan, using sufficient alum to make the precipitate coagulate, and washing by decantation with boiling water. Mr. Stoddart informs me that the results agree fairly with a modification of Allen's lead method, which he employs. I therefore purpose trying it at a future time; but the results can scarcely be very accurate, and it is improbable that all tannins combine with gelatin in the same proportions. This last objection is technically of less importance, however, since the power of precipitating gelatin is probably *somewhat* proportionate to that of making leather.

Some years ago Fleck announced a method depending on the fact that while tannin, gallic acid, and colouring matter are all precipitated by cupric acetate solution, the two latter are re-dissolved by ammoniac carbonate. He proposed, therefore, to employ a standard copper solution, and to estimate the excess by potassic cyanide. Dr. Watts showed that this was impracticable (owing to the fact, as I found, that cupric ammonio-gallate is not blue, but brown), but that gravimetrically some tannins might be estimated with considerable accuracy, while others gave precipitates more or less soluble in the ammoniac carbonate. The precipitate is complicated, and contains ammonia. Schiff gives its formula, in the case of digallic acid, as  $C_{14}H_4Cu_2(NH_4)_2O_9 + OH_2$  (*Ann. Chem. und Pharm.*, clxxv., 171), which would give 1 grm. of tannin (digallic acid) = 1.54 grms. precipitate, and 0.494 grm.  $CuO_{14}$ . Watts, employing the number 1.489 (deduced from the assumption, now shown to be incorrect, that the salt was a simple cupric tannate), obtained analytical results fairly agreeing with those by gelatin for valonia, sumach, divi, oak bark, galls, and myrabolans; and also for mimosa, by employing the number 0.2959 instead of 0.489. All tannins giving green precipitates with iron gave copper precipitates more or less soluble in ammonia.

No doubt this method, reckoning the tannin as two-thirds the weight of precipitate, or twice that of cupric oxide left on ignition, would give fair technical results; but it is unlikely that all the various tannins actually combine with copper in the same proportions. In fact, as we shall see later on, the different tannins differ notably in their properties and reactions, only agreeing in their power of precipitating gelatin, and I fear tanners will have to give up all hope of measuring them by one common standard. Indeed, to a chemist to do so seems about as reasonable as to compare the values of nitric and sulphuric acids by a standard solution of hydrochloric acid. Probably the differences between gallotannic, quercitannic, and catechu-tannic acids are quite as great as those of the mineral acids I have named. Chemists may fairly undertake to compare sumach with sumach, or bark with bark, but the relative values of the tannins of bark and sumach are commercial matters which no analysis can decide, though it doubtless might be done by carefully conducted technical experiments.

The disadvantages of the copper method are that it is slow, troublesome, and difficult, and that the washing and drying must be rapidly and carefully done, as the precipitate is easily decomposed. This difficulty might be overcome by igniting, and weighing the  $CuO$ , but this can only be done easily in oxygen, as otherwise the copper is so much reduced that it is apt to deflagrate with nitric acid or ammoniac nitrate. I think the best way is to filter on a vacuum filter, and dry in an air-bath (with a thermostat) at 100°.

The mean error of such result in a series of eight

\* Read before the Newcastle-upon-Tyne Chemical Society, March 22, 1877.

analyses of commercially "pure" tannin, containing apparently about 85 per cent digallic acid by the total employed, was only  $\pm 4.2$  per cent, a much better approximation than any of the foregoing. It is not likely that the results with tanning materials would be quite so good. Analyses of bark showed considerable divergence, and combustion of the precipitate proved that it was somewhat inconstant in composition, the Cu varying from 21.6 to 25.4 per cent. I fancy, too, that for oak-bark tannin two-thirds of the weight of precipitate is decidedly too high an estimate. It must also be borne in mind that if lime be present, as is often the case with tan-yard liquors, it will be precipitated as carbonate. This might be prevented by filtering off the precipitate before washing with ammoniac carbonate; but the method is troublesome enough without this, besides being of rather questionable accuracy.

Another process which has been much recommended is Mr. A. H. Allen's volumetric one, with a standard solution of acetate of lead, using as an indicator a mixture of ammonia and potassic ferricyanide. This is described in the last edition of Sutton, but in its original form is quite inadmissible, since lead precipitates gallic acid as well as tannin, and both react equally on the indicator. In combination with some of the differential processes in which the tannin is removed by gelatin or hide-raspings, it may no doubt give useful results, and, as the lead compounds of the different tannins are better known than most others, possibly factors might be calculated to give percentage results. I cannot insist too strongly that any calculation of percentages by comparison with "pure" tannin is utterly fallacious, both because the various tannins are of totally different constitution and because really pure tannin is quite unattainable. That met with in commerce only contains 80 to 90 per cent of really pure tannin, and is very variable.

Mr. Stoddart uses Mr. Allen's process in conjunction with absorption of tannin, with hide-raspings, when of course the loss is *proportional* to the tannin. He also employs Nelson's gelatin swollen in cold water as an absorbent in the same manner. Time and patience are necessary for the absorption of tannin thus, and it is seldom so complete that the results are not altered by prolonged digestion. In my experience the end reaction of Allen's method is not very distinct, and it is necessary carefully to filter the drops tested, as the indicator is affected by the precipitate. This makes the process somewhat tedious.

The remaining methods which I shall describe are all based on the oxidation of tannin by various agents, and all involve double analyses after absorption of the tannin, as tannin and gallic acid are almost identical in their behaviour with oxidisers.

Mittenzwey, and afterwards Terreil, proposed to estimate it by the direct absorption of atmospheric oxygen in alkaline solution—a difficult and tedious proceeding, though doubtless capable of some accuracy in skilful hands.

Monnier proposed to determine with permanganate direct, but this proved quite impracticable, since the oxidation is rapid at first, and then slow and with no definite termination.

To Dr. Löwenthal is due the capital improvement, which, with his recent additions, constitutes to my mind the most practical method of tannin analysis yet discovered. He adds to the *very* dilute tannin infusion a considerable quantity of indigo, not only to act as an indicator, but to control the oxidation of the tannin. This reaction is both rapid and accurate, and combined with his process of precipitation by gelatin will give results strictly comparative for any single tanning material. As it is likely to be of great practical importance I venture to give working details, referring for further particulars to Löwenthal's paper in the *Zeitschrift für Analytischen Chemie* (1877, p. 33), and to an excellent paper by Neubauer abstracted in the *C. S. Journal* (ix., 595).

Of solutions the following are required:—

1. Four grms. pure permanganate of potash in 3 litres of distilled water (or half decinormal answers well and saves calculation).
2. Five grms. of *pure* "precipitated indigo" in 1 litre of water (Woodroof Brothers, of Crutched Friars, supply a satisfactory article).
3. Dilute sulphuric acid (1 to 3 of water).
4. Twenty-five grms. of good transparent glue well swollen in cold water, and then dissolved by the aid of heat. The solution is made up to a litre, and saturated with pure salt (table salt).
5. A saturated solution of pure salt, containing 25 c.c. of sulphuric, or 50 c.c. of hydrochloric, acid per litre.

To make an analysis, 10 grms. of sumach or valonia, or 20 to 25 of bark, are exhausted by repeated boiling with portions of water, and the infusion, when cold, made up to 1 litre.

Of this infusion 10 c.c. are mixed with, say,  $\frac{3}{4}$  litre of good drinking water, 25 c.c. of the indigo solution, and 10 c.c. of the dilute sulphuric acid are added, and then the permanganate solution is run in *drop by drop* from the burette, with *constant* stirring, till the deep blue of the indigo changes to a clear yellow; and the moment this takes place we note the quantity of permanganate used. We will call this quantity A.

Next we repeat exactly the same process with the indigo and sulphuric acid alone, and will call the quantity B. Then, subtracting B from A, we obtain the amount of permanganate consumed by the total astringents of 10 c.c. of our tannin infusion. The permanganate acts, of course, as an oxidising agent, oxidising and consuming both the tannin and the indigo; but as the tannin is the most readily oxidised of the two it is consumed first, and when the indigo is all bleached we may be sure that the tannin is destroyed also. In order, however, to obtain this satisfactorily, the proportion of indigo should be such as to require about twice the quantity of permanganate which would be consumed by the tannin alone. Thus, if the indigo alone requires 10 c.c. of permanganate to decolourise it, the indigo and tannin infusion together must not take more than about 15 c.c., and if it does so the tannin infusion must be diluted accordingly, or a less quantity employed.

The next step is to ascertain the proportion of gallic acid and impurities in our sample. To this end we mix 100 c.c. with 50 c.c. of our salted gelatine solution, and then, after well stirring, add 100 c.c. of the salt and acid solution, and leave the mixture standing for some hours or all night, and then filter it through paper. The filtrate should be *completely* clear.

If we now test, say, 50 c.c. of this filtrate with permanganate and indigo as before, we shall obtain the amount of permanganate required for the gallic acid and impurities alone, since the tannin has been entirely precipitated, and the gelatine has so trifling an action on the permanganate that it may be safely neglected. To make the working clearer we will take an example from Dr. Löwenthal's paper:—

Ten grms. of sumach were boiled in  $\frac{3}{4}$  litre of water, and after cooling were made up to 1 litre.

(1) 10 c.c. sumach in-			
fusion .. ..			
25 c.c. indigo so-			
lution .. ..			
} consumed 16.6 c.c. permanganate.			
Ditto repeated .. ..	16.5	..	..
	33.1	..	..
50 c.c. indigo alone .. ..	13.2	..	..
Total permanganate for }			
20 c.c. sumach .. ..	19.9	..	..

(2) 50 c.c. filtrate from the gelatine ..	} consumed 11.2 c.c. permanganate.		
25 c.c. indigo solution ..			
Ditto repeated .. ..		11.1	„
		22.3	„
50 c.c. indigo alone .. ..		13.2	„

Gallic acid and impurities .. 9.1 „ „

Now, deducting 9.1 c.c. from 19.9 c.c., we have 10.8 c.c. as the permanganate equivalent to the tannin of 20 c.c. of sumach infusion, or 0.2 gm. of dry sumach. If it be desired to compare two sumachs, these proportional numbers are all that is necessary, and indeed it will be quite safe to use them for comparing sumach with galls or pure tannin. In the same way bark may be compared with bark, and valonia with valonia, but it will not be safe to attempt by this means to compare bark with sumach or with valonia, because the different species of tannin consume different proportions of permanganate. Oser states that 1½ grms. of oak-bark tannin consumes only the same quantity as 1 gm. of gall-nut tannin.

I may remark that where many analyses have to be performed the constant stirring becomes very tedious, and a stream of air-bubbles forced through the liquid by an aspirator may be substituted with great advantage.

Neubauer reckons 1 litre of decinormal permanganate as equal to 4.157 grms. of gallotannic acid, and consequently (according to Oser) to 6.235 of oak-bark tannin. Further research, however, is needed before percentages can be calculated with certainty, and chemists, in giving results, would do well to state the equivalent in permanganate, or to say that they use Neubauer's or Oser's equivalent. The first is applicable to sumach, galls, and myrabolans; the second probably to oak-bark, valonia, and chestnut extract, at least approximately. It is a singular fact that gallic acid consumes not only a larger proportion of permanganate, weight for weight, than tannin, but even a larger proportion than the tannin from which it is derived, as I proved by digesting a solution of tannin with dilute sulphuric acid, when its reducing power was notably increased. Hence commercial tannin, which is largely contaminated with gallic acid, consumes *more* permanganate than the above-mentioned quantity.

As to accuracy, single tests should never differ by more than 0.1 c.c., or say 2½ per cent of the total quantity; but of course, in so rapid a process, no one would rely on single tests, and by repeating and taking the mean any required accuracy may be attained. Separate portions of liquor precipitated by gelatine give identical results, at least within the limits named.

I should perhaps mention that Mr. Estcourt proposed some time since to precipitate with gelatine in conjunction with the permanganate method (CHEM. NEWS, vol. xxix., p. 110), but as he heated the solution, and tannate of gelatine is soluble in *hot* gelatine solution, the results were not satisfactory. Still he undoubtedly deserves the credit of the idea, while Löwenthal's *cold* gelatine solution, with the addition of salt and acid, completely overcomes the difficulty.

Several other oxidising methods have been proposed. Carpeni precipitates the tannin with ammonio-acetate of zinc, re-dissolves and estimates with permanganate. M. Jean oxidises with iodine in solution of sodic carbonate, and M. Pouchet with concentrated permanganate in a caustic potash solution. None of these methods seem to have any advantage over Löwenthal's, while the two latter are in my experience decidedly inferior. The end-reactions are much less distinct, and it is quite impossible to work them by artificial light, which is almost preferable with the indigo process, and is often a great convenience.

In speaking of the results I have obtained as a test of the accuracy of methods, I do not mean to convey that they are the *best* attainable, but simply such as would be likely to be obtained by a chemist of average skill and experience.

## ON CERTAIN CHEMICAL EFFECTS OF OXYGENISED GRAPHITE AND PLATINUM.\*

By WILLIAM SKEY,

Analyst to the Geological Survey of New Zealand.

IN the experimental results I am about shortly to describe I do not for the present distinguish between graphite, &c., as combined with a compound of oxygen such as nitric acid, which easily gives up oxygen, or graphite, &c., as combined with oxygen alone, either as oxygen or ozone. In some of them it is most probable that this acid, or a product of it, as absorbed by the graphite, operates for their production, while in others it really appears that it is oxygen which is the sole operant.

But as all these experiments were carried on in the presence of nitrogen, a gas which is, as we know, susceptible of being acted upon in certain cases by oxygen in such a manner that nitric or nitrous acids result,—and, further, as nitric acid is, as I have long since shown, absorbed by charcoal, and also, as will presently appear, by graphite and platinum too,—I cannot therefore as yet unreservedly attribute any of these results to the action of absorbed oxygen alone, although, as previously stated, I incline to this view.

Having thus defined the position I would hold for the present in regard to the bearing of these results, I will at once state them. They are as follows:—

1. That any surface of graphite, native or artificial, which has been for some time exposed to the air, liberates iodine from a solution of potassic iodide in weak sulphuric acid.
2. That graphite, which can thus liberate iodine, loses this property when washed in ammoniacal or other alkaline solutions; also by ignition.
3. That this property of liberating iodine is restored to such graphite by a short exposure of it to the air, or by evolving nascent hydrogen against it; also by digesting it for a little while with hydrochloric or weak sulphuric acid, either at a common temperature or at the boiling-point of these acids respectively.
4. That graphite, which thus liberates iodine, also rapidly determines a chemical effect upon mercury, when voltaically paired with it in pure hydrochloric acid, mercurous chloride forming.
5. That platinum can be substituted for graphite in the above experiments, with the same general results.

I further find that charcoal does not, even when freshly prepared, notably liberate iodine; but it can be made to do so by digesting it with an acid, the effect of which is perhaps due to its removing all alkaline matters therefrom, and thus enabling the charcoal to retain the oxidising agent necessary for effecting the liberation in view.

Silver, also, liberates iodine from the solution of it I have named here, and gold even appears to do this, but to a much less extent.

Nitric acid has the same effect upon either graphite or platinum (in relation to iodine) as exposure to air has, and prolonged washing of these metals afterwards does not in any way interfere with this effect, showing, no doubt, that this acid has been absorbed by these metals and is retained very obstinately.

The graphite I used was of course purified both from iron and manganese before being worked with.

In reference to the chemical action of substances upon which oxygen has been in some way condensed, I may perhaps be allowed to state further that when graphite, which has been exposed to the air, is voltaically connected in sea water with graphite just recently ignited, electric

\* Read before the Wellington Philosophical Society, January 29, 1876.

currents are generated; graphite which has been de-sulphurised also generates electric currents when connected in this manner with any negative conducting sulphide in a solution of an alkaline sulphuret. By the use of currents generated in this manner I have even electrolyted copper from its sulphate.

I forbear making any specific deductions from the results above related until I can supplement them in such a way as will enable me to discriminate, with greater surety than I at present can, the exact nature of the absorptive process by which graphite and platinum become chemically active in the way these results indicate.

## NOTICES OF BOOKS.

*The Textile Colourist, a Monthly Journal of Bleaching, Printing, Dyeing, and Finishing Textile Fabrics.* Edited by C. O'NEILL, F.C.S. Vol. iii. Manchester: Palmer and Howe. London: Simpkin and Marshal.

THE present volume of the *Textile Colourist* contains a large amount of valuable matter. The "History of Textile Colouring"—a department which the Editor appears to have studied with much care—is continued, and brings to light not a few interesting facts. Thus in a book on bleaching, published by a Dr. Home more than a hundred and twenty years ago, we find the first steps towards a volumetrical analysis of alkaline ashes. The standard acid employed was a mixture of 1 part of spirit of nitre with 6 parts of water, and "the estimation was by the number of tea-spoonfuls of acid required to finish the effervescence of a given weight of ashes." Still, as Mr. O'Neill adds, "the principle was there." The same Dr. Home expresses also very advanced views on the benefits to be derived from the mutual interchange of knowledge among practical men. Says he—"There is nothing promotes an art faster than the communication of those who practise it; nothing retards it more than a selfish spirit of keeping all a secret." To this passage and to Mr. O'Neill's comments thereon we must express our hearty assent.

There are here, also, some useful extracts from De Vinant's work on dyeing, printing, and bleaching; from Kœppelin, on silk-printing; and from Depierre's treatise on the washing-machines used in the tinctorial arts. There are "Notes from Mulhouse," containing a summary of novelties from that important focus of dyeing and printing. We find it here mentioned that the very minute traces of vanadium which M. Witz stated as sufficient for the development of aniline-black have in other hands required augmenting to four or ten times the amount. The discovery of vanadiferous minerals, such as Roscoelite, is therefore highly opportune. It is also reported that the steel doctors are attacked by the vanadium colour, though to a less extent than by the copper sulphide. There are also notes from the rival industrial society, that of Rouen, which is displaying an admirable amount of activity. We regret, however, to find that the English contributions to the arts of dyeing and printing bear so small a proportion to those derived from abroad. Whether our industrial leaders are resting on their oars, or whether each man carefully keeps to himself the improvements he effects, and prefers the protection of secrecy to that of the patent office, we are unable to decide. In this case we hope they will take to heart Mr. O'Neill's exhortation on p. 74.

The *Textile Colourist* is taking its full share in the great war against the jog-trot, rule-of-thumb spirit which still haunts so many of our manufacturers, and we therefore wish it success.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 2, July 9, 1877.

**Alcoholate of Chloral.**—E. Wurtz.—The ebullition point of this compound is higher than that of the hydrate, which would be an anomaly in case of compounds capable of boiling without decomposition. Its vapour-density, like that of the hydrate, answers to 4 volumes. The dehydration of crystalline oxalate of potassa takes place as readily in the vapour of chloral alcoholate as in the air. This is not the case with the hydrate.

**On Electric Transmission through the Soil by the Intervention of Trees.**—Th. du Moncel.—The author draws the following conclusions from his experiments:—Trees are all more or less conductors, and their conductivity depends on the quantity of liquid which they contain. The roots of a tree play the part of electrodes, and their efficacy as agents of transmission is in relation with the conductivity of the tree and with their development. The resistance of a tree setting out with the leaves—and supposing contact only made with a few of them—varies, in round numbers, from 2 to 400,000 kiloms. of telegraphic wire; that of the trunk, at the height of 7 to 8 metres, does not greatly exceed, with the intervention of the soil, 3000 kiloms. There is consequently no great reason to be afraid of the contact of telegraphic wires with the leaves of trees.

**Diamagnetism of Condensed Hydrogen.**—R. Blondlot.—Graham had found hydrogenium-palladium more magnetic than palladium. Wiedemann ascribes this result to iron present as an impurity in Graham's palladium and reduced by the hydrogen. Blondlot agrees with Wiedemann, and finds that condensed hydrogen is powerfully diamagnetic.

**Photometric Researches on Coloured Flames.**—M. Gouy.—Not suitable for abstraction.

**On a New Metal, Davyum.**—Sergius Kern.—Described in an original paper by the author.

**Oxidisability of Manganic Sulphide.**—Ph. de Clermont and H. Guiot.—A quantity of the flesh-coloured sulphide is carefully washed with pure water on a filter; the filter is rapidly pressed between folds of blotting-paper and placed in a vacuum over concentrated sulphuric acid. After three days it is taken out of the vacuum and exposed to the air, when it immediately takes fire, giving off sulphurous acid and leaving sulphate and brown oxide of manganese.

**On a New General Method for the Synthesis of Hydrocarbons, Acetones, &c.**—C. Friedel and J. M. Crafts.—The chloride of zinc and the ferric and ferrous chlorides are capable of acting similarly to the chloride of aluminium.

**Action of Bromine on Pyro-tartaric Acid.**—E. Bourgoin.—On heating to 120° 10 parts of pyro-tartaric acid with 24 of bromine and 10 of water, Lagermark obtained bromoform, bromoxaform, bromo-citraconic anhydride, an oily product of a tar-like odour, and a colourless acid not yet isolated. The author, on repeating his experiment, obtains only a single crystalline body having the composition and properties of Kekulé's bromo-citraconic anhydride.

**Determination of Carbonic Acid in Blood Serum.**—L. Fredericq.—The author defends his method against the strictures of MM. Mathieu and Urbain.

**Researches on Bitter Almonds.**—M. Portes.—investigation on the origin and locality of amygdalin bitter almonds.

**Nickeliferous Iron of Santa Catarina (Brazil).—**M. Lunay.—An account of a meteorite originally weighing about 7000 kilos., and containing from 7.8 to 34.6 per cent of nickel.

**Comparative Study of Cupreous Compounds introduced into the Stomach and the Blood.**—V. Feltz and E. Ritter.—Insoluble albuminate of copper introduced into the stomach has scarcely any effect on the system. The soluble albuminate occasions affections fully as severe as those produced by the ammoniacal sulphate in distilled water. Sulphate of copper dissolved in syrupy glycerin is much more poisonous than the same salt dissolved in aqueous glycerin. A solution of albuminate of copper containing 0.0015 grm. of copper per c.c. occasions death as soon as the dose introduced exceeds 0.0015 grm. per kilo. of the weight of the animal. A salt of copper introduced into the stomach does not become poisonous until the system has absorbed the quantity just mentioned as proving fatal in the blood. The chief channels for the elimination of copper, placed in the order of their importance, are the bowels, the liver, and the kidneys.

**Detection of Salicylic Acid.**—H. Martz.—The author points out that Robinet's method for the detection of this acid in wines and urine is erroneous. He considers it preferable to agitate with a few c.c. of ether previously acidulated with hydrochloric acid, and allow the ethereal solution to evaporate spontaneously, whilst floating upon a weak solution of ferric chloride, when it produces an intense violet-coloured ring.

No. 3, July 16, 1877.

**Carbuncle and Septicæmia.**—MM. Pasteur and Joubert.—The authors contend, in opposition to M. Paul Bert, that the sole cause of carbuncle is a microscopic organism—the *Bacteridia*.

**Experiments according to which the Fragmentary Form of Meteoric Irons may be ascribed to a Fracture produced by Strongly-compressed Gases, such as those Generated by the Explosion of Dynamite.**—M. Daubrée.—This paper cannot be satisfactorily abstracted without the insertion of the illustrations, but its nature appears sufficiently from the title.

**Researches on the Compressibility of Liquids (Continuation).**—E. H. Amagat.—The compressibility of the successive terms of the family of formenic carbides decreases regularly as we descend in the series, both at 100° and at common temperatures. Benzol is much less compressible than amylen hydride, which contains the same number of equivalents of carbon. In the series of alcohols, and in that of their acetates, the ratio of these variations, which is inversely as that of the densities, may differ according to temperature, and at an elevated temperature tends to become the same as in the series of carbonates. The presence of sulphur, chlorine, and bromine in liquids tends to render them less compressible. If we compare the compressibility of amylen hydride with those of common ether and of hydrochloric ether, we may conclude that very probably the first terms of the series of formenic carbides are bodies endowed with the greatest compressibility in the liquid state.

**Electric and Capillary Properties of Mercury in contact with Different Aqueous Solutions.**—M. Lippmann.—The author's experiments lead to this conclusion:—For each value of the electromotive force the capillary constant has a single determined value independent of the chemical composition of the liquid. In other words, if for two different compounds the electromotive force is the same, the capillary constant is the same likewise.

**Vapours of the Chloral Alcoholates.**—L. Troost.—The author finds that the densities of the vapours of the ethylate, methylate, and amylate of chloral, like that of the hydrate, correspond to 8 volumes.

**Action of Light upon Hydriodic Acid.**—G. Lemoine.—Hydrogen and oxygen do not combine sensibly

in the cold under the influence of light. Dry gaseous hydriodic acid, if pure and not mixed with air, may be preserved in absolute darkness for more than a year. As soon as light is admitted decomposition begins, as is shown by the deposition of solid iodine, but the process is very slow even in full sunlight. This reaction is null between the red and the green rays, but is effected in the violet and the blue. The result of four days' exposure to the sun, as found by determining the hydrogen set free, was—

		Approximate Thickness.	Hydriodic Acid Decomposed.
White glass	.. ..	0.5 m.m.	0.08
Red	.. ..	0.5 "	0.00
Green	.. ..	0.8 "	0.00
Blue	.. ..	0.9 "	0.04
Violet	.. ..	1.3 "	0.01

The slow decomposition of gaseous hydriodic acid by light may serve in great meteorological observations to measure the degree of illumination of the heavens. The aqueous solution of hydriodic acid, whether dilute or concentrated, is not affected by light. Such solutions, however, as well as the gaseous acid, are decomposed by the oxygen of the air, even in the dark.

**On a New Derivative of Indigotin.**—P. Schutzenberger.—The following results have been obtained with pure indigotin, prepared by agitating an alkaline solution of white indigo in contact with air:—It was then heated in a closed vessel to 180° C., with twice its weight of the crystallised hydrate of baryta, 1½ times its weight of powdered zinc, and ten times its weight of water, for forty-eight hours. At the outset there was formed an alkaline solution of white indigo, a true vat; but after two days of heating the liquid on exposure to the air ceased to yield blue indigotin. At the bottom of the autoclave was found an insoluble powder, chiefly mineral, and consisting of zincate of baryta, carbonate of baryta, and zinc in powder. This residue yields to alcohol an organic substance which gives a brown colour to the solvent. On evaporation to dryness this alcoholic solution leaves an amorphous resinous residue of a deep colour, brittle in the cold, but becoming soft under 100°. This residue was mixed with zinc powder, and the mixture heated by portions of 10 grms. in a small porcelain crucible, set in a sand-bath and heated by a Bunsen burner. The crucible was covered with filter-paper, upon which rested the lid. The interior of the crucible then became lined with long and beautiful crystalline needles of a light yellow, resembling sublimed anthraquinon. They are fusible at 245°, insoluble in water, soluble in ether and alcohol, to which they communicate a bluish fluorescence. On analysis they give numbers agreeing exactly with a polymer of indol,  $x(C_8H_7N)$ . The new body has well-defined basic properties, and forms crystalline compounds with acids. The author has given it the name indolin. It dissolves in hot dilute hydrochloric acid, and the solution forms with platinic chloride a yellow, granular, crystalline precipitate. Concentrated sulphuric acid dissolves indolin with a blue fluorescence, and the solution on exposure to the air deposits—as it becomes hydrated—yellow crystalline grains of indolin sulphate. Indolin sublimes sometimes in needles resembling anthraquinon, sometimes in leaflets like anthracen, but always leaving a carbonaceous residue.

**Properties of Resorcin: a Thermo-Chemical Investigation.**—L. Calderon.—The author finds that resorcin behaves like a diatomic phenol.

**Reform of Certain Analytical Procedures used in the Laboratories of Agricultural Stations and of Chemico-Meteorological Observatories.** (Second Memoir, Acidimetry.)—A. Houzeau.—Reserved for insertion in full.

**Nature of the Acids contained in the Gastric Juice.**—C. Richet.—The organic acid soluble in ether and contained in the gastric juice is the sarcocollatic.

Experiments proving that neither Air nor Pure Oxygen, when Compressed, are able to Destroy the Septicity of Putrid Blood.—V. Feltz.—Putrid blood loses nothing of its septicity by prolonged contact with air or oxygen at a high tension. The compressed air has no action upon the organised ferments whose existence in putrid blood is demonstrated by the microscope. Pure oxygen, at very high and prolonged pressures, destroys the vibriones, but has no action on the co-co-bacteria. Its influence is very similar to the desiccation of putrid blood by exposure to the sun. It is impossible by this method of experimentation to separate in putrid blood organised ferments from diastasic ferments.

*Bulletin de la Societe Chimique de Paris,*  
No. 9, May 5, 1877.

Reduction of Aniline-Black, and its Conversion into a Rose Colouring Matter.—M. Goppelsröder.—Already noticed.

Transformation of Ordinary Pyro-tartaric Acid into the Hydrobromate of Tribromated Ethylen.—M. E. Bourgoïn.—Already noticed.

Note on the Determination of the Sugars and of the Acidity in Forty-three Varieties of Apples.—M. A. Truelle.—The author describes his mode of procedure at length, and gives the results in the form of a table. In all the apples examined inverted sugar and cane-sugar were present in mixture, but in very different proportions. The White Calville contains 6.377 per cent of inverted sugar to 5.600 of cane-sugar. In the Grey Fenouillet we have 13.386 per cent of inverted sugar, and merely 0.839 of cane-sugar. The largest total percentage of sugar, 14.440 per cent, occurred in the Red American Rennet; smallest amount, 7.280 per cent, in the Pomme d'Eve. The highest acidity, equal 2.274 per cent of  $\text{SO}_4\text{H}$ , was in the Calville de Maussion; in no other variety did the acid reach 1 per cent, and in the Grey Fenouillet it was found = 0.

Derivatives of Dinitrated Naphthalin, Alpha and Beta.—M. A. Atterberg.

Constitution of the Alpha Derivatives of Naphthalin.—M. A. Atterberg.—These papers are not adapted for useful abstraction.

A number of papers on organic chemistry, given in abstract, are taken from *Liebig's Annalen* and from *Ber. der Deutsche Chem. Gesell.*, and have been, or will be, duly noticed under those heads.

Aniline-Bronze.—O. Fiorillo.—In 100 grms. of alcohol at 95 per cent, heated in the water-bath, are dissolved 10 grms. of rosein and 5 grms. of methyl-violet; 5 grms. of benzoic acid are then added, and the whole is allowed to boil for some minutes until the green colour of the mixture has changed to a golden bronze. The colour produced is brilliant and solid. It adheres easily to paper, paper-pulp, wood, glass, leather, &c., and is applied with a brush.—*Dingler's Polytechnisches Journal*, ccxxi., 487.

Thao, a New Material for Dressing Textile Goods.—Thao is the gelatinous part of certain algæ employed in Cochin China. Its utilisation extends to various manufactures, and its chief future seems to be in finishing stuffs. It may be extracted from certain sea-weeds from the coast of Bretagne. It has been said to be difficult of solution, and to be contaminated with a yellow colouring matter. If previously macerated for about twelve hours, thao may be dissolved in boiling water in ten to fifteen minutes. The solution, if strained and stirred till completely cold, does not congeal into a jelly, but remains fluid, and can thus be applied cold without injuring the colours of the stuffs. The yellow principle is eliminated by prolonged boiling, and is deposited in an insoluble crust on the sides of the pan. As thao dissolves only with the aid of heat, goods saturated with it are not affected by

moisture. The solutions of thao do not turn mouldy, and have no action upon the solution of permanganate. It may also be employed in the manufacture of gold-beaters' skin.—*Moniteur de la Teinture*.

Removing Oil from Woollen and Cotton Waste.—This process, patented in Germany, consists in mixing the waste in a drum with plaster of Paris. When the plaster, after a prolonged contact, has absorbed the fatty matter, the mixture is transferred to another drum pierced with holes, through which the bulk of the plaster escapes. The rest is removed by beating.

Reagent for Wool and Cotton in Mixed Fibres and Tissues.—E. Liebermann.—The reagent is magenta mixed with an alkali so as to liberate its colourless base. The thread or stuff is plunged into the clear liquid, and then washed in water. The red colour of magenta reappears, on exposure to air, upon the woollen fibres, whilst the cotton remains colourless and readily distinguishable. The direct use of a coloured solution of magenta does not give results equally distinct.

The Temperature and the Composition of the Gases of Ultramarine-Furnaces.—F. Fischer.—The temperature necessary for the production of ultramarine is about 700°. The great dilution of the sulphurous acid gas given off, and the irregularity of its evolution, prevent its utilisation in the lead chambers. Carbonic oxide is only exceptionally present.—*Dingler's Polytechnisches Journal*, ccxxi., 468.

Gilding and Silvering Glass and Porcelain.—E. Hansen.—Sulphur is dissolved in the essential oil of lavender to a semi-fluid consistence. With this is mixed an ethereal solution of the chloride of gold or of platinum, and the whole is concentrated anew at a gentle heat. The composition thus obtained is applied with a pencil to the surfaces to be metallised, after which they are placed in the muffle, and carefully heated till the sulphur and other volatile matters are expelled. There is formed thus a deposit of gold or of platinum, which may receive a uniform layer of silver, gold, or platinum by the galvanic method.—*Polytech. Notizblatt*.

Aniline-Black Incapable of Turning Green.—C. F. Brandt.—To prevent the "greening" of aniline-blacks it is sufficient to pass the dyed pieces through a weak solution of aniline-violet. For printed goods, the white grounds are cleared with chlorine and a boiling soap-bath. The black thus treated does not turn green, even after immersion in a solution of sulphurous acid.—*Moniteur de la Teinture and Bnll. de la Soc. Ind. de Mulhouse*.

Solubility of Silk in an Alkalino-Glyceric Solution of Copper.—M. J. Löwe.—The solvent is prepared as follows:—Dissolve 10 grms. sulphate of copper (pure) in 140 to 160 c.c. of distilled water, add 8 to 10 grms. of glycerin at 1.24 specific gravity, drop in caustic soda until the precipitate of hydrate of copper is re-dissolved, and then filter. An excess of soda should be avoided. This liquid dissolves silk more or less rapidly according to the degree of concentration, but has no such action upon cotton, linen, or wool. Silks dyed black with salts of iron should be previously digested in an alkaline sulphide, and the sulphide of iron formed removed by the subsequent application of weak hydrochloric acid. Other dyes do not retard the process of solution. Wool is coloured black by the alkalino-glyceric solution of copper, but this colouration is easily removed by an acid bath.—*Dingler's Polytech. Journal*.

*Fustus Liebig's Annalen der Chemie,*  
Band 187, May 12, 1877.

Communications from the Laboratory of the University of Würzburg.—These consist of a paper on Benzoyl-acetic-ester,  $\text{C}_{13}\text{H}_{14}\text{O}_4$ , by Julius Bonné; a memoir on Benzyl-acetic-ester,  $\text{C}_{13}\text{H}_{16}\text{O}_3$ , by F. L. Ehrlich; and a paper on Allyl-acetic-ester,  $\text{C}_9\text{H}_{14}\text{O}_3$ , by F. Zeidler.

**On a Problem of Dissociation.**—A. Horstmann.—When a solid body is dissociated into gaseous constituents the process is externally very similar to evaporation, from which it is, however, distinguished by the fact that the pressure which can arrest and even reverse dissociation is not exerted by a single gas, but by a gaseous mixture. This leads to the author's problem. If such a gaseous mixture is formed by decomposition in a vacuum—the ordinary case when vapour tension is to be measured—the constituents are always mixed in one and the same proportion, as they form the solid body. But what happens if one of the constituents is in excess? Taking as an example carbamate of ammonia, which is dissociated into 1 mol.  $\text{CO}_2$  and 2 mols.  $\text{NH}_3$ . If it is formed or decomposed in an atmosphere of excessive carbonic acid (or of ammonia), will the maximum tension of dissociation, which in this case sets a limit to the formation or dissociation, be the same as in a vacuum or not? In other words, will the separate pressure of the free ammonia be the same in an excess of carbonic acid as in a properly composed gaseous mixture? The author, by a series of experiments, has shown that without exception the vapour-tension is greater in presence of ammonia or carbonic acid than in a vacuum, and that the vapour-tension of carbamate of ammonia is always greater in carbonic acid than in ammonia of equal density.

**On Meta-methol-camphor.**—P. Perrenoud.—In this paper the author describes the preparation of meta-nethol-camphor by the action of melting chloride of zinc—the method to which he gives the preference; the formation of meta-nethol-sulpho-camphoric acid, with its calcium and barium salts; and of meta-nethol-sulpho-camphoric chloride. He also describes a modification of V. Meyer's method of determining vapour-densities at low temperatures.

**Researches on Certain Urinary Deposits** (Communicated by B. Tollens).—These researches consist of a paper on "Phosphatic Sediments in Alkaline Urine," by C. Stein; and "Contributions to the Knowledge of Cistinuria in Man," by A. Niemann.

**On Thio-glycollic Acid.**—Peter Claesson.—The author finds that the mono-sulpho-glycollic acid is not pure thio-glycollic acid, but a mixture. He has examined several of its derivatives, such as hydrargyro-thio-glycollic acid, cuprosum-thio-glycollic, and similar compounds into which other metals enter.

**On Normal Hexylic Alcohol and Normal Cœnanthylic Acid.**—A. Lieber and G. Janecek.—The authors conclude that the capronic acid formed by fermentation along with butyric acid is identical with the synthetic normal acid of Lieben and Rossi, and with the capronic acid obtained by Franchimont and Zincke by the oxidation of hexylic alcohol prepared from the oil of heracleum.

*Reimann's Fürber Zeitung,*  
No. 26, 1877.

This issue contains a sketch of the history of calico-printing in India, its original home, and also a continuation of the charges of piracy brought against a certain Belgian paper.

No. 27, 1877.

|| This issue is chiefly devoted to the proposed School of Tinctorial Art in Berlin.

*Moniteur Scientifique, Quesneville.*  
May, 1877.

**Certain Little-known Causes of the Deterioration of Steam-boilers.**—In contact with certain kinds of water fatty matters introduced into a boiler may become a grave source of danger. Even the purest distilled water without the presence of grease cannot be recommended: it attacks the iron and produces a rapid deterioration, whilst waters slightly calcareous leave the metal absolutely

unattacked. The subject requires the careful attention of chemists.

**Contribution to the Knowledge of the Alkaloids of Cinchona.**—J. E. de Vry.

**On Cinchonidin.**—L. Pasteur.

**Sulphate of Cinchonidin.**—L. Pasteur.

**Contributions to the History of Conquinon.**—O. Hesse.

These important chemico-pharmaceutical papers do not admit of abstraction.

## TO CORRESPONDENTS.

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# THE CHEMICAL NEWS.

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## BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

PLYMOUTH MEETING, AUGUST 15, 1877.

### INAUGURAL ADDRESS OF THE PRESIDENT,

PROFESSOR ALLEN THOMSON, M.D., LL.D.,  
F.R.S., F.R.S.E.

AFTER the long interval of six and thirty years the British Association for the Advancement of Science holds its annual meeting, the forty-seventh since its foundation, in this beautiful and interesting locality; and, strangely enough, on this occasion as on the former, it passes from Glasgow to Plymouth. We are delighted to be assembled here, and are even surprised that the Association has been able so long to resist the power of attraction by which it has been gravitating towards this place. While we are prepared to be charmed with the surpassing beauty of its scenery, and know the deep interest of its pre-historic vestiges, its historic memories, and its artistic associations, we have been frequently reminded of its scientific vigilance by the records of its active scientific work; and we are now ready and anxious to witness all we can behold of its energy and success in the application of scientific discovery to the practical arts. Should we, as might be expected in a place hitherto so famous in its relations to our naval and military history, find most prominent those relating to the mechanism of war, we shall still hope that the effect of greater perfection in the engines of destruction may only be the means of rendering peace more permanent and secure.

It is a source of regret to myself, and may be, I fear, a cause of detriment to this Meeting, that the choice of a President should have fallen upon one whose constant occupation with very special branches of science has fitted him so inadequately for the distinguished position to which he has been called. I can only derive comfort from knowing that, wherever it may be necessary, there are many others present most able to supply what may be wanting on my part; and I must therefore at once bespeak their assistance and your indulgence.

I have selected for the subject of the remarks which I am about to offer for your acceptance a biological topic, namely, the "Development of the Forms of Animal Life," with which my studies have been occupied, and which has important bearings on some of the more interesting biological questions now agitating the scientific world. But before proceeding with the discussion of my special subject, it is my desire to call your attention shortly to the remarkable change in the manner of viewing biological questions which has taken place in this country during the last half-century—a change so great, indeed, that it can scarcely be fully appreciated except by those who have lived through the period of its occurrence.

In the three earlier decades of this century it was the common belief, in this country at least, shared by men of science as well as by the larger body of persons who had given no special attention to the subject, that the various forms of plants and animals recognised by naturalists in their systematic arrangements of genera and species were permanently fixed and unalterable, that they were not subject to greater changes than might occur as occasional

variations, and that such was the tendency to the maintenance of uniformity in their specific characters that, when varieties did arise, there was a natural disposition to the return, in the course of succeeding generations, to the fixed form and nature supposed to belong to the parental stock; and it was also a necessary part of this view of the permanency of species that each was considered to have been originally produced from an individual having the exact form which its descendants ever afterwards retained. To this scientific dogma was further added the quasi-religious view that in the exercise of infinite wisdom and goodness, the Creator, when He called the successive species of plants and animals into existence, conferred upon each precisely the organisation and the properties adapting it best for the kind of life for which it was designed in the general scheme of creation. This was the older doctrine of "Direct Creation," of "Teleological Relation," and of "Final Causes;" and those only who have known the firm hold which such views had over the public mind in past times can understand the almost unqualified approbation with which the reasoning on these questions, in writings like the "Bridgewater Treatise" (not to mention older books on Natural Theology), were received in their time, as well as the very opposite feelings excited by every work which presented a different view of the plan of creation.

On the Continent of Europe, it is true, some bold speculators, such as Goethe, Oken, Lamarck, and Geoffroy St.-Hilaire, had, in the end of the last and commencement of this century, broached the doctrine that there is in living beings a continuous series of gradations as well as a consistent and general plan of organisation, and that the creation, therefore, or origin of the different forms of plants and animals must have been the result of a gradual process of development or of derivation one from another, the whole standing connected together in certain causal relations. But in Britain such views, though known and not altogether repulsive to a few, obtained little favour, and, by some strange process of reasoning, were looked upon by the great majority as little short of impious questionings of the supreme power of the Almighty.

How different is the position of matters in this respect in our day!—when the cautious naturalist receives and adopts with the greatest reserve the statement of fixed and permanent specific characters as belonging to the different forms of organised beings, and is fully persuaded of the constant tendency to variation which all species show even in the present condition of the earth, and of the still greater liability to change which must have existed in the earlier periods of its formation; when the belief prevails that, so far from being the direct product of distinct acts of creation, the various forms of plants and animals have been gradually evolved in a slow gradation of increasing complexity; and when it is recognised by a large majority of naturalists that the explanation of this wonderful relation of connexion between previously existing and later forms is to be found in the constant tendency to variation during development and growth, and the perpetuation of such variations by hereditary transmission through successive generations in the long but incalculable lapse of the earth's natural mutations. These, as you must all be aware, are in their essential features the views now known as Darwinism, which were first simultaneously brought forward by Wallace and Darwin in 1858, and which, after being more fully elaborated in the works of the latter and ably supported by the former, secured, in the incredibly short space of ten or twelve years, the general approval of a large portion of the scientific world. The change of opinion is, in fact, now such that there are few scientific works on Natural History, whether of a special or more general character, in which the relation which the facts of science bear to the newer doctrines is not carefully pointed out; that, with the general public too, the words "Evolution" and "Development" have ceased to excite the feelings, amounting almost to horror, which they at first produced

in the minds of those to whom they were equally unfamiliar and suspicious; and that, even in popular literature and ephemeral effusions, direct or metaphorical illustrations are drawn in such terms of Darwinian theory as "struggle for existence," "natural selection," "survival of the fittest," "heredity," "atavism," and the like.

It cannot be doubted that in this country, as on the Continent, the influence of authority had much to do with the persistence of the older teleological views; and, as has been well remarked by Haeckel, one of the ablest and keenest supporters of the modern doctrine, the combined influence more especially of the opinions held by three of the greatest naturalists and biologists who have ever lived, viz., Linnæus, Haller, and Cuvier (men unsurpassed in the learning of their time, and the authors of important discoveries in a wide range of biological science), was decidedly adverse to the free current of speculative thought upon the more general doctrines of biology. And if it were warrantable to attribute so great a change of opinion as that to which I have adverted as occurring in my own time to the influence of any single intellect, it must be admitted that it is justly due to the vast range and accuracy of his knowledge of scientific facts, the quick appreciation of their mutual inter-dependence, and, above all, the unexampled clearness and candour in statement of Charles Darwin.

But while we readily acknowledge the large share which Darwin has had in guiding scientific thought into the newer tracks of biological doctrine, we shall also be disposed to allow that the slow and difficult process of emancipation from the thralldom of dogmatic opinion in regard to a system of creation, and the adoption of large and independent views more consistent with observation, reason, philosophy, and religion, has only been possible under the effect of the general progress of scientific knowledge and the acquisition of sounder methods of applying its principles to the explanation of natural phenomena.

I have already referred to Goethe, Oken, Lamarck, and Geoffroy St.-Hilaire as among the most prominent of the earlier pioneers in the modern or reformed conceptions of biological laws. But were it desirable to mark the progress of opinion by quoting other authors and labourers whose contributions have mainly supplied the materials out of which the new fabric has been constructed, I should have to produce a long catalogue of distinguished names, among which would be found those of Lyell and Owen, as earliest shaping the doctrines and guiding opinion in this country. Johannes Müller and Von Baer, as taking the places of Haller and Cuvier on the Continent, and a host of other faithful workers in Biology belonging to the earlier part of this century, such as those of G. Treviranus, J. F. Meckel, Carus, and many more.\* To Huxley more especially and Herbert Spencer the greatest influence on British thought in the same direction is to be ascribed.

Let us hope that in these times, when it has been found necessary to modify the older teleological views to so great an extent, although there may still be much that is unknown, and wide differences of opinion in regard to the nature and sequence of natural phenomena and the mode of their interpretation, all naturalists will now concur in one important principle, viz., that truthful observation and candid judgment must alone be our guides in the interpretation of Nature, and that that theory of Creation is most deserving of our adoption which is most consistent with the whole body of facts carefully observed and compared.

To attempt to trace, within the limits to which my re-

\* It would also be unjust to omit to mention here one of the earliest attempts to bring British opinion into a new channel, by the remarkable work entitled "Vestiges of Creation," which appeared in 1844, nor to conceal from ourselves the unmerited ridicule and obloquy attempted to be thrown upon the author, not perhaps so much on account of the many inaccuracies unavoidable in an attempt at the time to overtake so large a field, as directed against the dangerous tendencies supposed to lurk in its reasoning.

marks must be confined, the influence which the progress of knowledge has exercised upon the scientific and general conception of biological doctrines would be impossible, for the modification of opinion on these subjects has proceeded not less from the rapid advance which our age has witnessed in the progress of general science, especially of physics and chemistry, than from that of departments belonging to biology itself.

Thus, to go no further than the most general laws of Nature, the whole doctrine of the conservation and transmutation of force in physics, so ably expounded to this Association by Mr. Justice Grove, the theory of compound radicals and substitution, with the discovery of organic synthesis, in chemistry, and the more recent advance in speculation with regard to the molecular constitution and properties of matter, with which we must associate the names of our last President and of Clerk Maxwell, in completely changing the aspect of physical and chemical sciences within the last thirty-five years, have paved the way for views of the constitution and action of organised bodies very different from those which could be formed at the time of the first Meeting of the Association in this place. And if, confining ourselves to the department of Biology, we add the discovery by microscopical observation of the minuter elementary forms of organisation, more especially as flowing from the comprehensive views of organised structure promulgated by Schleiden and Schwann nearly forty years ago, the later discovery and investigation of living protoplasmic substances, the accumulated evidence of progressive types of animal and vegetable forms in the succession of superimposed strata composing the crust of the earth, the recent discoveries as to the conditions of life at great depths in the ocean, the vast body of knowledge brought together by the labours of anatomists and physiologists as to the structure and functions of almost every plant and animal, and (still more, perhaps, than any other single branch of biological inquiry) if we note the rapid and immense progress which has been made during the last fifty years in the study of the entirely modern science of the development of living beings, we shall be able to form some conception of the enormous extension in our time of the basis of observation and fact from which biological phenomena may now be surveyed, and from which just views may be formed as to their mutual relations and general nature.

It is now familiarly known that almost all (if not, indeed, all) the plants and animals existing on the earth's surface derive their origin from parents or previously existing beings whose form and nature they closely reproduce in their life's history. By far the greater number spring from germs in the form of visible and known spores, seeds, or eggs; a few may be traced to germs, or to vestiges of the parental body, the exact nature of which may be doubtful; and some, including even a certain number of those also produced from known germs, are either constantly or occasionally multiplied by budding, or by a process of cleavage or direct and visible division of the parent body.

The germ constituting the basis of new formation, whether it have the form of spore, seed, or ovum, is of the simplest kind of organisation, and the process by which a new plant or animal is produced is necessarily one of gradual change and of advance from a simpler to a more complex form and structure: it is one of "evolution," or, as I would rather name it, "development." But before proceeding to discuss the subject of development in the higher animals, it is right to advert to the preliminary and often-debated question, which naturally presents itself, viz., "Do all living or organised beings, without exception, spring from germs, or from any kind of organised matter that has belonged to parents? or may there not be some, especially among the simpler forms (with regard, indeed, to which alone there has of late been any question), which are produced by the direct combination of their component elements, in the way of the so-called

spontaneous or equivocal generation, heterogenesis or abiogenesis?

The importance of the right solution of this problem is not confined merely to the discovery of the mode of origin of the lowly organisms which have been the more immediate object of investigation by naturalists in recent times, but is one of much wider significance, seeing that, if it shall be satisfactorily proved, or even rendered probable, that in the course of cosmical development all the various kinds of plants and animals have been gradually produced by evolution out of pre-existing simpler forms, and thus the whole series of organised beings in Nature has been shown to be one of hereditary connexion and derivation, then it would follow that the history of the origin of the simplest organisms may be the key to that of the first commencement of life upon the earth's surface, and the explanation of the relation in which the whole succeeding progenies stand to their parental stocks.

From the very lucid and masterly view of this subject given by Prof. Huxley in his Address to the Association at Liverpool, so recently as in 1870, in which the conclusion he formed was based very much on the exhaustive and admirable researches of Pasteur, I might almost have dispensed with making further reference to it now, but for the very confident statements since made by the supporters of the doctrine of abiogenesis, among whom Dr. Bastian stands most prominent in this country, and for the circumstance that the life-history of many of the lower organisms was still imperfectly known.

During the last seven or eight years, however, renewed investigations by most competent inquirers have followed one another in quick succession, from a review of which we cannot but arrive at a conclusion adverse to the theory of heterogenesis, viz., that no development of organisms, even of the most simple kind, has been satisfactorily observed to occur in circumstances which entirely excluded the possibility of their being descended from germs, or equivalent formative particles, belonging to pre-existing bodies of a similar kind. I can do no more now than name the authors of the most conclusive experiments on this subject, which I do nearly in the order of the publication of their researches, as those of Mr. W. N. Hartley in 1872, Messrs. Pöde and Ray Lankester in 1873, Dr. Burdon Sanderson in that and the following years, Dr. W. Roberts in 1874, Prof. Lister in 1875, and most recently of Prof. Tyndall, Prof. Cohn, and of Messrs. Dallinger and Drysdale.\*

But, admitting that the evidence from direct experiment is such as entirely to shut us out from entertaining the view that spontaneous generation occurs in the present condition of the earth, we are not relieved from the difficulty of explaining how living organisms or their germs first made their appearance, nor are we debarred from attempting to form hypotheses as to how this may have taken place. First, upon the theory of Evolution, which, strictly carried out, supposes the more complex organisms

to be derived from the more simple, it might be held that the conditions affecting the combination of the primary elements of matter into organic forms may at one time have been different from those which now prevail, and that, under those different conditions, abiogenesis may have been possible, and may have operated to lay the foundations of organic life in the simpler forms in which it at first appeared—a state of things which can only be vaguely surmised, but in regard to which no exact information can be obtained. Or, secondly, evading the difficulty of strict cosmical evolution, we might suppose that vital conditions may have been coeval with the first existence of physical and chemical properties in the rest of natural bodies. But this hypothesis would be exposed to the objection that, according to the cosmical view generally held by physicists, the whole materials composing the earth have originally been subjected to incandescent heat. Nor is the difficulty abolished, but only removed to a more remote period, by the supposition of the transport of germs from another planet or their introduction by means of meteorites or meteoric dust; for, besides the objection arising from the circumstance that these bodies must have been subjected to a very high temperature, we should still have everything to learn as to the way in which the germs arose in the far distant regions of space from which they have been conveyed.

The incompleteness of the geological record leaves us in the dark as to the time at which the first dawns of life appeared in the lower strata of the earth's surface. The most recent researches tend to carry the origin of life back to a much earlier period than was at one time believed, and (if the famous *Eozoon* be admitted as evidence) even into that of the Laurentian strata. But even if doubts should prevail with regard to the presence of definite organised forms in the older sedimentary strata, the occurrence in them of carbon in the form of graphite in large quantities makes the previous existence of living organisms at least possible, and it may be that the complete metamorphosis which these rocks have undergone has entirely removed all definite traces of organisation.

Nor have we the means from geological data of determining whether the beings of the vegetable or of the animal kingdom first made their appearance. If we adopt the view which has for some time been entertained by physiologists, that animals are entirely dependent, directly or indirectly, on plants for the material which constitutes their living substance, and that plants, as constructive agents, alone have the power to bring together the elements of lifeless matter, from such states as carbonic acid, water, and ammonia, into the condition of the living solid, the inference would be inevitable, at least for the great majority of the animal creation, that they must have been preceded by plants. But palæontology is as yet silent on this interesting question; and, if we consider the remarkable approach which is made in structure and properties between the lowest and simplest members of the two kingdoms of organic nature, so that at last all distinction between them seems entirely to vanish, and a set of organisms is found which partake equally of animal and vegetable characters, or, rather, exhibit properties which are common to them both, we shall hesitate to postulate confidently for the primitive antecedence of vegetable life, although, perhaps, in later epochs the pre-existence of vegetables may be looked upon as necessary to the life of more developed animal organisms.

The reflection forces itself upon us that we are just as ignorant of the mode of first origin of all the compounds of the inorganic elements as we are of that of living matter; and we may therefore be excused if we suspend all theory and conjecture until we shall be guided to more reliable hypotheses through the plain track of observation and experiment.

The practical applications of the increased knowledge of the origin of minute animal and vegetable organisms are so numerous that it would occupy a much longer time

\* I may refer to Dr. Bastian's paper in *Nature* of June 30, 1870, and to his two works, "The Origin of the Lowest Organisms" and "The Beginnings of Life," and papers to Roy. Soc., 1873. Mr. Hartley's researches, which were commenced in 1865, are described in a paper printed in the *Proceedings of the Royal Society* for 1872, and in his "Lectures on Air, 2nd edition, 1876, where an interesting account of the whole subject will be found. The experiments of Mr. Pöde, of Oxford, and Prof. Ray Lankester are described in a paper on the "Development of Bacteria in Organic Infusions," in the *Proc. Roy. Soc.*, 1873, vol. xxi., p. 349. Dr. Burdon Sanderson's researches are contained in the "Reports of the Medical Officer of the Privy Council," and in various papers in *Nature*; Dr. W. Roberts's paper is printed in the *Transactions of the Royal Society* for 1874, vol. clxiv., p. 457. Prof. Lister's "Contribution to the Germ Theory of Putrefaction and other Fermentative Changes," &c., is contained in the *Transactions of the Royal Society of Edinburgh* for 1875, p. 313, and is also given in *Nature*. Prof. Tyndall's researches are described in his papers in the *Proceedings of the Royal Society* during the last two years. The work of Prof. Cohn, of Breslau, entitled "Beiträge zur Biologie der Pflanzen," 1873–76, contains many memoirs bearing upon this subject, which have been partly published in abstract in the *Microscopical Journal*, in which also will be found, in a series of contributions extending from 1873 to the present time, the interesting observations of Mr. W. H. Dallinger and Dr. J. Drysdale.

than is at my disposal to give any detailed account of them; but they are of such immense importance in their commercial, social, and sanitary relations that they ought never to be lost sight of.

It is now proved beyond doubt that the origin of putrefaction and fermentation is dependent on the presence in the substances which are the seat of change in these processes, or in the surrounding air, of the germs of minute organisms of an animal or vegetable nature, and that the maintenance of the chemical changes in which these processes mainly consist is coincident with and casually (if not essentially) dependent upon the growth and multiplication of these organisms.

Professor Lister had the merit of being the first to apply the germ theory of putrefaction to explain the formation of putrid matters in the living body; and he has founded on this theory the now well-known antiseptic treatment of wounds, the importance of which it would be difficult to over estimate.

The success or failure of plans for the preservation of meat and other articles of food without question depends on the possibility of the complete exclusion of the germs which are the cause of putrefaction and fermentation; and their management must therefore be founded on the most accurate knowledge of these organisms, and the circumstances influencing the persistence of their vitality and the vigour of their growth.

The theory of Biogenesis has also lately been the guide in the investigation of the causes of various forms of disease, both in the lower animals and in man, with the result of showing that in many of them the infective substance consists, in all probability, of germs of minute animal or vegetable organisms.

There is very great probability, indeed, that all the Zymotic diseases (by which we understand the various forms of fevers) have a similar origin. As has been well remarked by Baxter in an able paper on "The Action of Disinfectants," the analogies of action of contagia are similar to those of septic organisms, not to processes simply of oxidation or deoxidation. These organisms, studied in suitable fluids, multiply indefinitely when introduced in all but infinitesimal proportions. Thus they are, as near as we can perceive, the very essence of contagia.\*

Leaving, however, these and many other general questions regarding the origin of the lowest forms of animal and vegetable life, let us now turn our attention to the mode of development of a new being in those belonging to the higher groups. The general nature of the formative process, in all instances where fertilised germs are produced, will be best understood by a short sketch of the phenomena ascertained to occur in different kinds of plants.

In the higher or phanerogamic plants it is generally well known that the combination of two parts of the flower is necessary to the production of a seed containing the embryo or young plant. Beginning with the discovery of the pollen-tubes by Amici in 1823, the careful and minute investigations of a long line of illustrious vegetable physiologists have brought to light the details of the process by which fertilisation is effected, and have shown, in fact, how the minute tube developed from the inner membrane of the pollen-granule, as soon as it falls upon the stigmatic tissue of the seed-bearing plant, insinuates itself by a rapid process of development between the cells of the style, and reaches at last the ovule, in the interior of which is the embryo-sac; how, having passed into the micropyle or orifice of the ovule, it makes its way to the embryo-sac; how a minute portion of the fertilising substance of the fovilla transudes from the pollen-tube into the cavity of the embryo-sac, in which by this time a certain portion of

the protoplasm has become differentiated into the germinal vesicle—thereby stimulating it to further growth and development, the earliest phenomena of which manifest themselves by the formation of an investing cell-wall, and by the occurrence of cell-division, which results in the formation of the embryo or plantule of the seed.

Thus it appears that the essential part of the process of production in phanerogamic plants is the formation in the parent plant of cells of two different kinds, which by themselves have little or no independent power of further growth, but which, by their union, give rise to a product in which the power of development is raised to the highest degree.

By further researches it is now known that the same law prevails in all the remaining members of the vegetable kingdom, with the exception only of the very simplest forms.\*

In viewing the reproductive process in the series of Cryptogamic plants, two facts at once strike us as remarkable in the modifications which are observed to accompany the formation of a productive germ, viz.:—First, that the difference between the two productive elements becomes as it were more prominent, or more highly specialised, in the Cryptogamic than in the Phanerogamic plants; and, second, that in the simpler and lower forms this difference gradually disappears till it is lost in complete uniformity of the productive elements.

Thus in the whole tribe of the Ferns and Vascular Cryptogams, in the higher Algæ and Fungi, in the Characeæ and in the Mosses, the differentiation of the productive elements is carried to a very high degree; for while that belonging to the embryo or germ presents the structure of a simple cell which remains at rest, or in a comparatively passive state, and, absorbing into itself the substance of the other, becomes the seat of subsequent development, the other, corresponding to the pollen of the staminiferous phanerogam, is usually separated from the place of its formation, and, having undergone a peculiar modification of structure by which it acquires active moving cilia, it changes place and is directed towards the germinal structure, and, coming in contact with its elementary cell, is more or less absorbed or lost in the fertilising process. The protoplasm of the germinal cell thus acted on and fertilised then proceeds to undergo the changes of development by which the foundation is laid for the new plant.

In the Algæ and Fungi, however, there are gradations of the differentiation of the two reproductive cells which are of the greatest interest in leading to a comprehension of the general nature of the formative process. For in the lower and simpler forms of these plants, such as the Desmidiæ, Mesocarpeæ, and other Conjugatæ, we find that there is no distinction in structure or form to be perceived between the two cells which unite or undergo conjugation; and a complete fusion or intermixture of the two masses of protoplasm results in the production of a single, usually spherical, mass holding the place of an embryo. And that there is an absence of specialisation between the two uniting cells is clearly shown, in both *Desmidium* and *Mesocarpus*, by the fact that the embryo or zygospore is formed in the mass resulting from the union of the protruded portions of the two cells; and in more ordinary cases, as in *Spirogyra*, where the embryo is formed in one of the two cells, it seems to be indifferent in which of them it is formed.

From this, which may be regarded as the most elementary type of new production by the union of the two cells, the transition is not a great one to the development of a progeny without any such union. We might conjecture, then, that the capacity for separate or individual existence extends in the lowest organisms to the whole or to each structural element of their organisation, while as we rise in the scale of vegetable life (and the same view might apply to the animal kingdom) this capacity is more and

\* For the most interesting information on this subject I cannot do better than refer to the very able Reports by Dr. Burdon Sanderson in the "Reports of the Medical Officer of the Privy Council," 1873, 1874, and 1875.

\* It will be observed that I leave entirely out of view the whole subject of the multiplication of plants by budding or simple division.

more divided between the two productive elements, or, at least, is only called into full action by their combination.

The germinal element consists of a simple primordial cell, varying in different kinds of plants, but in all of them probably containing the essential substance protoplasm; and the most immediate result or effect of fertilisation is the multiplication by repeated fissiparous division of the previously existing cells. The new individual resulting from this cellular growth usually remains within the parent body, without, however, direct union or continuity of tissue, till the embryo has attained some advancement, as in the well-known case of the seeds of a phanerogam; but there are many varieties in the mode of its disposal among the lower plants.

A remarkable exception to the more direct relation of the process of fertilisation to the formation of the new individual or embryo occurs in some plants, simulating in some respects that kind of variation in animal reproduction which has been named alternate generation. A well-known instance of this belongs to the Vascular Cryptogams. The prothallium of the Ferns, for example, results from the development of so-called spores or unicellular buds, which are familiar as being formed in small capsules on the lower leaf-surface; and in this prothallium, when it has reached a certain stage of vegetation, there are formed the archegonia, containing the oospheres or germ-cells, which are fertilised by the moving ciliated particles developed in the cells of the antheridia, leading to the production of a new spore-bearing plant.

Recent researches have also called attention to the remarkable arrangements in Phanerogamic plants for the prevention of fertilisation of the pistils by pollen from the same flower, or even from the same plant. In the latter case this is effected by the separation of stamens and pistils in different flowers on the same or on different plants. In the former case, where both organs occur in the same flower, the adaptations, whether of a mechanical or of a physiological character, by which self-fertilisation is prevented, as ascertained by numerous recent investigations (among which those of Darwin are most conspicuous), are of the most varied and often the most complicated kind.

Let us now turn to the consideration of the Development of Animals; and let me say in the outset that it will be necessary for me to confine my remarks chiefly to the higher or vertebrated animals, and to certain parts only of the history of their development—more particularly the structure and formation of the ovum or egg, its earlier developmental changes, and the relation of these to the formation of the new animal.

I cannot enter upon the consideration of this topic without adverting to the very recent acquisition of some of the most important facts upon which this branch of knowledge is founded; and I feel it to be peculiarly appropriate, in the year of his death, to refer to a biologist whose labours contributed more powerfully than those of any other person to give to animal embryology the character of a systematic branch of science, and to whom we owe some most important original discoveries—I mean Karl Ernest von Baer, of Königsberg, St. Petersburg, and Dorpat.

Of observers who, previous to Von Baer, were mainly instrumental in preparing the way for the creation of a more exact modern science of embryology only two can be mentioned, viz., Caspar Frederick Wolf, of St. Petersburg, well known as the author of a work entitled "*Theoria Generationis*," published in 1759, by which the *epigenesis* or actual formation of the organs in a new being was first demonstrated, and Christian Pander, who, by his researches made at Würzburg, explained, in a work published in 1817, the principal changes by which the embryo arises and is formed.

Von Baer was born in the Russian province of Esthonia on the 29th of February, 1792. After having been fifteen years Professor in the Prussian University of Königsberg, he was called to St. Petersburg, and having some years

later been appointed to a newly established professorship of Comparative Anatomy and Physiology, he remained in that city for nearly thirty years as the most zealous and able promoter of scientific education and research, stimulating and guiding all around him by his unexampled activity, comprehensive and original views, sound judgment, and cordial co-operation. In 1868, at the age of 76, he retired to Dorpat, from the University of which he had received his degree in 1814, and continued still to occupy himself with working and writing in his favourite subjects, as well as interesting himself in everything that was related to educational and scientific progress, to very near the time of his death, which occurred on the 28th of November, 1876, in his 85th year.

Although Von Baer's researches, according to the light in which we may now view them, contributed in no small degree to the introduction of the newer views of the morphological relations of organic structure which have culminated in the Theory of Descent, yet he was unwilling to adopt the views of Darwin; and one of his latest writings, completed in the last year of his life, was in vigorous opposition to that doctrine.

It would have been most interesting and instructive to trace the history of the progress of discovery in Embryology from the period of Von Baer down to the present time; but such a history would not be suitable to the purpose of this address; and I can only venture here, in addition to Rathke, the colleague of Baer in Königsberg, to select two names out of the long list of distinguished workers in this field during the last forty years, viz.:—Thomas Bischoff, of Giessen and Munich, to whom we owe the greatest progress in the knowledge of the development of Mammals, by his several memoirs, appearing from 1842 to 1854; and Robert Remak, of Berlin, whose researches on the development of Birds and Batrachia, appearing from 1850 to 1855, gave greatly increased exactness and extension to the general study of development.

The germinal element from which, when fertilised, the new animal is derived is contained within the animal ovum or egg—a compact and definite mass of organic matter, in which, notwithstanding great apparent variations, there is maintained throughout all the members of the animal kingdom, excepting the Protozoa, which are destitute of true ova, a greater uniformity in some respects than belongs to the germinal product of plants.

Usually more or less spherical in form, the animal ovum presents the essential characters of a "complete cell," in the signification given by Schwann to that term. The germinal substance is enclosed by an external vesicular membrane or *cell-wall*. Within this covering the *cell-substance* (generally named yolk or vitellus, from the analogy of the fowl's egg) consists, to a greater or less extent, of a mass of protoplasm; and imbedded in this mass, in a determinate situation, there is found a smaller internal vesicular body, the *germinal vesicle* or nucleus, with its more or less constant or variable *macula* or nucleolus.

Now the first thing which strikes us as remarkable connected with the ovum is the very great variation in size as compared with the entire animal, while in all of them the same simple or elementary structure is maintained. The ovum of mammals is, for example, a comparatively small body, of which the average diameter is about  $\frac{1}{100}$  of an inch, and which consequently scarcely weighs more than a very minute fraction of a grain, which may be calculated perhaps only at the  $\frac{1}{125000}$  part. And, further, in two animals differing so widely in size as the elephant and the mouse, the weights of which may be held to stand towards each other in the proportion of 150,000 to 1, there is scarcely any difference in the size of the mature ovum.

On the other hand, if we compare this small ovum of the mammal with the yolk of the egg in the common fowl, the part to which it most nearly corresponds, it may be

estimated that the latter body would contain above three millions of the smaller ova of a mammal.

The attribute of size, however, in natural objects ceases to excite feelings of wonder or surprise as our knowledge of them increases, whether that be by familiar observation or by more scientific research. We need not, at all events, on account of the apparent minuteness of the ovum of the mammifer or of any other animal, have any doubts as to the presence of a sufficient amount of germinal substance for explaining in the most materialistic fashion the transmission of the organic and other properties and resemblances between the parent and offspring. For we are led to believe, by those who have recently given their attention to the size of molecules composing both living and dead matter, that in such a body as this minute ovum of the mammal there may be as many as five thousand billions of molecules: and even if we restrict ourselves to the smaller germinal vesicle, and, indeed, to the smallest germinal particle which might be made visible by the highest microscopic enlargement, there are still sufficient molecules for all the requirements of the most exacting material biologist.\*

This great disparity of size, however, is connected with an important difference in the disposition of the yolk-substance, according to which ova may be distinguished as of two kinds—the large- and the small-yolked ova, between which there are also many intermediate gradations. The larger-yolked ova belong to the whole tribe of birds, scaly reptiles, osseous and cartilaginous fishes, and the Cephalopods among the Invertebrates; and are distinguished by the strictly germinal part or protoplasm being collected into a small disk, known familiarly as the cicatrix of the fowl's egg, and to be seen as a whitish spot on that side of the yolk which naturally floats uppermost, while the rest of the yolk, of a deeper yellow colour, contains a large quantity of vitelline granules or globules of a different chemical nature from the protoplasm.

The phenomena of embryonic development are, in the first instance at least, confined to the germinal disk, and the rest of the yolk serves in a secondary or more remote manner to furnish materials for nourishment of the embryo and its accessory parts. Thus we distinguish the germinal from the nutritive or food-yolk, or, as the younger Van Beneden has named them, the *protoplasm* and the *deutoplasm*.

In the smaller ovum of the mammal, on the other hand, it seems as if the whole, or nearly the whole, of the yolk were protoplasmic or germinal. There may be some admixture of yolk-granules; but there is not the marked separation or limitation of the protoplasmic substance which is so distinct in birds, and the earliest changes of development extend to the whole component substance of the yolk, or, in other words, the yolk is entirely germinal. Hence some have given the names of *meroblastic* and *holoblastic* (meaning partially and entirely germinal) to these two contrasting forms of ova. There are many of the invertebrate animals of which the ova present the same entirely germinal arrangement as in those of mammals, and the *Amphioxus* may be included in the same group.

The Amphibia stand in some measure between the two extremes—the purely protoplasmic or germinal part occupying one side, and the nutritive or vitelline the other. But among the Invertebrates the gradations are often such as to make it difficult to determine under which group the ova should be placed.

The genesis or formation of the ovum itself, it it be con-

sidered with reference to its first origin, carries us back to a very early period of the formation of the parent in which it is produced; and it is one of the most interesting problems to determine what is the source of the cells in the parent from which the ova originally spring. All that I can venture to say at present in regard to this point is, that the primordial ova or germs appear in the parental body, while still embryonic, at a very early period of its development, and clearly derive their origin from a deeply-seated part of the formative cells which are undergoing transformation into the primitive organs; but the exact seat of the origin of the reproductive cells is still a matter of doubt.

When the ovum attains its full maturity in the ovary, the seat of its formation within the parent, it is separated from that organ, and when perfected proceeds to undergo embryonic development, a marked difference in this respect existing between the germinal product of the higher plants and animals.

The period of maturation of the ovum is marked in the greater number of animals by a series of phenomena which have generally been interpreted as the extrusion or absorption of the germinal vesicle; and various observers have actually traced the steps of the process by which that vesicle appears to leave the yolk and is lost to sight, or has passed into the space between the yolk and its membrane in the shape of the peculiar hyaline bodies named the *polar* or *directing* globules. But recent researches, afterwards to be referred to, tend to show that some part at least of the substance of the germinal vesicle remains to form, when combined with the fertilising element, the newly endowed basis of future development.

Among the earliest changes to which the perfect animal ovum is subject, I have first to refer to the segmentation of the germ, a series of phenomena the observation of which has been productive of most important results in leading to a comprehension of the intimate nature of the formative process, and which is of the deepest interest both in a morphological and histological point of view. This process, which was first distinctly observed by Prevost and Dumas more than fifty years ago, and is now known to occur in all animal ova, consists essentially in the cleavage or splitting up of the protoplasmic substance of the yolk, by which it becomes rapidly subdivided into smaller and more numerous elements, so as at last to give rise to the production of an organised stratum of cells out of which, by subsequent changes, the embryo is formed.

The process of yolk-segmentation may at once be distinguished as of two kinds, according as it affects in the small-yolked ova the whole mass of the yolk simultaneously, or in the large-yolked ova is limited to only one part of it. The cleavage process, in fact, affects the germinal and not the food-yolk; so that to take the two most contrasting instances of the bird and mammal, to which I have before referred, it appears that while the mammal's ovum undergoes entire segmentation, this process is confined to the substance of the cicatrix or germinal disk of the bird's egg. This process is essentially one of cell-division, but it is also in some measure one of cell formation. The best idea of its nature will be obtained from a short description of the total segmentation occurring in the mammal's ovum.

When, as before mentioned, the germinal vesicle has been in part extruded or lost to sight, the whole yolk-substance of the ovum forms a nearly uniform mass of finely granular protoplasm, enclosed within the external cell-membrane. Within a few hours later a clear nucleus has arisen in this mass. To this more definite form of organisation assumed by the germinal substance of the future animal, which is about to be the subject of the segmenting process, the name of the first segment-sphere may be given.

By the process of cleavage which now begins, this first segment-sphere and its nucleus undergo division into two nucleated spheres of smaller size, the whole substance of

\* According to a calculation made by Mr. Sorby, the number of molecules in the germinal vesicle of the mammalian ovum is such that if one molecule were to be lost in every second of time the whole would not be exhausted in seventeen years. See Address to the Microscopic Society, in *Journ. of Microscop. Science*, vol. xv., p. 225, and *Nature*, vol. xiii., p. 332. See also Darwin on "Pangenesis," in his work on "Variations," &c. (1868), vol. ii., p. 374, and the Review by Ray Lankester of Haeckel's work, "Perigenesis der Blastidule," &c., in *Nature* for 1876, p. 235, and Ray Lankester's essay on "Comparative Longevity," 1870.

the yolk, in a holoblastic ovum, such as that of the mammal, being involved in the segmenting process.

The second stage of division follows after the lapse of a few hours, and results in the formation of four nucleated segment-spheres; and the process of division being repeated in a certain definite order, there result in the succeeding stages (that is, the third, fourth, fifth, and up to the tenth) the numbers of 8, 12, 16, 24, 32, 48, 64, and 96 nucleated yolk-spheres, germ-spheres, or formative cells.

In the rabbit's ovum the tenth stage is reached in less than three days; and as during that time the size of the whole ovum has undergone very little increase, it follows that the spheres of each succeeding set, as they become more numerous, have diminished greatly in size. These segment-spheres are all destitute of external membrane, but are distinctly nucleated; and their protoplasmic substance is more or less granular, presenting the usual histological characters of growing cells.

By the time that segmentation has reached the seventh or eighth stage, when 32 or 48 spheres have been formed, the ovum has assumed the appearance of a mulberry, in which the outer smaller spheres, closely massed together, project slightly and uniformly over the whole surface; while the interior of the ball is filled with cells of a somewhat larger size and a more opaque granular aspect, also resulting from the process of segmentation.

Already, however, the mutual compression of the spheres or cells on the surface, by their crowding together, has led to the flattening of their adjacent sides; and by the time the tenth stage is reached, when the whole number of the cells is about 96, the more advanced superficial cells, having ranged themselves closely together, form a nucleated cellular layer or covering of the yolk, enclosing within them the larger and more opaque cells, derived like the first from the segmenting process. In a more advanced stage, the deeper cells now referred to having also taken the form of a layer, there results at last the bilaminar blastoderm or embryonic germinal membrane.

The process of partial segmentation, such as occurs in the bird's egg, though perhaps fundamentally the same as that of the mammal previously described, stands in a different relation to the parts of the whole yolk or egg, and consequently differs in its general phenomena. The segmentation is mainly restricted in the meroblastic ova of birds to the germinal disk of cicatricula, and does not immediately involve any part of the larger remainder of the yolk. This takes place during the time of the descent of the yolk through the oviduct, when the yolk is receiving the covering of the white or albumen, the membrane, and the shell previous to being laid—a progress which, in the common domestic fowl, usually occupies less than twenty-four hours. Corresponding essentially to the more complete segmentation of the mammal's ovum, the process leads to the same result in the production of two layers of nucleated formative cells in the original seat of a protoplasmic disk—a bilaminar blastoderm resulting as in the mammal's ovum, though in a somewhat different relation to the yolk.

I will not fatigue you with a description of the details of these phenomena, interesting as they may be, but only mention generally that they consist in the formation of deep fissures running from the surface into the substance of the germ-disk. The first of these fissures crosses the disk in a determinate direction, dividing it into two nearly equal semicircular parts. In the next stage another fissure, crossing the first nearly at right angles, produces four angular segments. Then come four intervening radial fissures which subdivide the four segments into eight; and next afterwards the central angles of these eight radial segments are cut off from their peripheral portions by a different fissure, which may be compared to one of the parallels of latitude on the globe near the pole where the radial or *longitude* fissures converge. And so thereafter, by the succession and alternation of radial and circular clefts (which, however, as they extend outwards, come soon to lose their regularity), the whole

germinal disk is divided into the two layers of nucleated cells, constituting the blastoderm or germinal membrane of Pander and all subsequent embryologists.\* If a laid egg be subjected to the heat of incubation for eight or ten hours, the cicatricula, now converted into this segmented blastoderm, is found to be considerably expanded by a rapid multiplication of its constituent cells; and in as many more hours, by further changes in its substance, the first lineaments of the chick begin to make their appearance. Similar changes affect the blastoderm of the mammal; and thus it appears that the result of segmentation, in the bird as well as in the mammal and other animals, is the production of an organised laminar substratum, which is the seat of the subsequent embryonic development.

I must still request your attention to some details connected with the process of segmentation, which bear upon the question of the origin of the new cells, and on which recent research has thrown a new and unexpected light.

With respect to the nature of the first segment-sphere of the ovum and the source of its nucleus, as well as of the other segment-spheres or cells which follow each other in the successive steps of germ-subdivision, it appears probable, from the researches of several independent observers, and more especially of Edward van Beneden and Oscar Hertwig, that in the course of the extrusion of the germinal vesicle a small portion of it remains behind in the form of a minute mass of hyaline substance, to which Van Beneden has given the name of *pronucleus*, and that, as the result of the fertilising process, there is formed a second similar hyaline globule or pronucleus, situated near the surface, which gradually travels towards the centre and unites with the first pronucleus, and that these two pronuclei, being fused together, form the true nucleus of the first segment-sphere. According to this view the original germinal vesicle, when it disappears or is lost to sight, as described by so many embryologists, is not dissipated, but only undergoes changes leading to the formation of the new and more highly endowed nucleus of the first embryonic or segmental sphere. It further appears that the subdivision of each segmenting mass is preceded by a change and division of the nucleus, and that this division of the nucleus is accompanied by the peculiar phenomenon of a double conical or spindle-shaped radial lineation of the protoplasm, which, if we were inclined to speculate as to its nature, seems almost as if it marked out the lines of molecular force acting in the organising process. These lines, however, it will be understood, if visible with the microscope, even of the highest magnifying-power yet attained, belong to much larger particles than those of the supposed molecules of the physicist; but, considered in connexion with what we know of the movements which frequently precede the act of division of the yolk-spheres, we seem in this phenomenon to have made some near approach to the observation of the direction in which the molecular forces operating in organisation may be supposed to act.†

\* The more exact nature of the process of segmentation was first made known by the interesting researches of Bagge in 1841, and more especially of Kölliker in 1843. The phenomena of complete segmentation were first fully described in the mammal's ovum in Bischoff's description of the development of the Rabbit, 1842, and followed out in his succeeding memoirs on the Dog, Guinea-pig, and Roedeer. The phenomena of partial segmentation were first made known, in their more exact form, by Kölliker's researches on the development of the Cephalopoda, published in 1844. In birds the process was first described by Bergmann in 1845, and more fully by Coste in 1848.

† The observations referred to above as to the division of the nucleus are so novel and of such deep interest that I am tempted to add here a short abstract of their more important results from a very clear account given of them by Dr. John Priestley, of Owens College, Manchester, in the *Journal of Microscopical Science* for April, 1876.

The researches now referred to are those of Auerbach, Butschli, Strasburger, Hertwig, and Edw. Van Beneden; and the following may be stated as the points in which they mainly agree:—

The nucleus when about to divide elongates into a spindle-shaped body, becomes irregular and indistinct, acquires a granular disk or zone in the plane of its equator; this divides into two, and each half moves towards the pole of the spindle on its own side, there being radiated lines of protoplasm between the poles and the equatorial disk.

With respect to the nature of the blastoderm, the organised cellular stratum resulting from segmentation, and its relation to the previous condition of the ovum on the one hand, and the future embryo on the other, there is presented to us, by modern research, the interesting view that the blastoderm consists, after completion of the segmenting process, of two layers of cells—an outer or upper (usually composed of smaller, clearer, and more compact nucleated cells) named *ectoderm* or *epiblast*, and an inner or lower (consisting of cells which are somewhat larger, more opaque and granular, but also nucleated), named *endoderm* or *hypoblast*.

In the meroblastic ova, such as those of birds, the bilaminar blastoderm is discoid and circumscribed as it lies on the yolk-surface, and only comes to envelop the whole of the food-yolk in the progress of later development; while in the holoblastic ova, and more especially in mammals, the blastoderm from the first extends over the whole surface of the yolk, and thus forms an entire covering of the yolk known as the "vesicular blastoderm," the space within being occupied by fluid.

Huxley long ago presented the interesting view that these two layers are essentially the same, in their morphological relations and histological structure, as the double wall of the body in the simplest forms of animals above the Protozoa; and Haeckel has more recently followed out this view, and supported it by his researches in the Calcareous Sponges, and has founded upon it his well-known *Gastræa* theory. According to this view all animals take their origin from a form *Gastrula*. In the simpler tribes, as in the instance of the common freshwater polype or *Hydra*, they proceed no further than the *Gastrula* stage, unless by mere enlargement and slight differentiation of the two primitive layers of cells representing the persistent *ectoderm* and *endoderm*.\*

If, pursuing this idea, we take a survey of the whole animal kingdom in its long gradation of increasing complexity of form and structure from the simplest animal up to man himself, we find that all the various modifications of organic structure which present themselves are found, in the history of the individual or ontological development of the different members of the series, to spring originally from two cellular laminæ, *ectoderm* and *endoderm*, the component elements of which may again be traced back to the first segment-sphere and primitive protoplasmic elements of the ovum.

Time does not admit of my conducting you through the chain of observation and reasoning by which Haeckel seeks to convince us of the universal applicability of his theory; but I cannot avoid calling your attention to the extremely interesting relation which has been shown to

The disk segments are the new nuclei, and the subsequent division of the cell takes place in the intermediate space.

Although these observers still differ in opinion upon some of the details of this process, and especially as to the fate of the germinal vesicle, all of them seem to agree that there are two pronuclei or distinct hyaline parts of the yolk-protoplasm, a superficial and a deep one, engaged in the formation of the new nucleus; and both Hertwig and Van Beneden are of opinion that the two proceed from different productive elements.

The radiated structure of the nuclei had been previously recognised by Fol and Flemming, and further observed by Oellacher.

1. Butschli's researches are published in the *Nov. Act. Nat.-Cur.*, 1873, and in the *Zeitschr. für Wissensch. Zool.*, vol. xxv.

2. Auerbach's observations in his "Organolog. Studien," 1874.

3. Strasburger's observations in his memoir "Ueber Zellbildung und Zelltheilung," Jena, 1875.

4. Edward Van Beneden's researches, partly in his memoir "On the Composition and Significance of the Egg," &c., presented to the Belgian Academy in 1868, and more particularly in the extremely interesting preliminary account of "Researches on the Development of Mammalia," &c., 1875, and in a separate paper in the *Journal of Microscopical Science* for April, 1876.

5. Oscar Hertwig's memoirs are contained in the *Morpholog. Jahrbuch*, 1875, and his most interesting and novel observations in the same work, 1877.

\* At this place I will only refer to one of the most recent of Haeckel's works, in which the views alluded to above are fully exposed in a series of most interesting memoirs, viz., "Studien zur Gastræa-Theorie," Jena, 1877; and to Dr. E. Percival Wright's translation of the account of Haeckel's views in *Journ of Microsc. Science*, vol. xiv., 1874.

exist between the primary phases of development of the ovum and the foundation of the blastoderm in very different groups of animals, more especially by the researches of Haeckel himself, of Kowalevsky, Edward Van Beneden, and others, and which has received most efficient support from the investigations and writings of E. Ray Lankester in our own country; so that now we may indulge the well-grounded expectation that, notwithstanding the many and great difficulties which doubtless still present themselves in reconciling various forms with the general principle of the theory, we are at least in the track which may lead to a consistent view of the relations subsisting between the ontogenetic, or individual, and the phylogenetic, or race history of the formation of animals and of man.\*

In all animals, then, above the Protozoa, the ovum presents, in some form or other, the bilaminar structure of *ectoderm* and *endoderm* at a certain stage of its development, this structure resulting from a process of segmentation or cell-cleavage; and there are three principal modes in which the double condition of the layers is brought about. In one of these it is by inward folding or invagination of a part of the single layer of cells immediately resulting from the process of segmentation that the doubling of the layers is produced; in the second, perhaps resolvable into the first, it may be described rather as a process of enclosure of one set of cells within another; while in the third the segmented cells, arranged as a single layer round a central cavity of the ovum, divide themselves later into two layers. But the distinction of *ectodermic* and *endodermic* layers of cells is maintained, whether it be primitive and manifested from a very early period, or acquired later by a secondary process of differentiation. Thus in many Invertebrates, as also in *Amphioxus* among the Vertebrates, a distinct invagination occurs, while in Mammals, as recently shown by Van Beneden's most interesting observations in the rabbit's ovum, and probably also in some Invertebrates, the cells of the *ectoderm* gradually spread over those of the *endoderm* during the progress of segmentation, and thus the *endodermic* comes to be closed by the *ectodermic* layer of cells.

From the very novel and unexpected observations of Van Beneden it further appears that from the earliest period in the process of segmentation in the mammal's ovum it is possible to perceive a distinction of two kinds of segment-spheres or cells, and that when this process is traced back to its first stage it is found that the whole of the cells belonging to the *ectoderm* are the progeny of, or result from the division of the upper of the two first formed segments, and that the whole of the *endodermic* cells are the descendants of the lower of the two first segmented cells. This, however, is not an isolated fact belonging only to mammalian development, but one which very nearly repeats a process ascertained to occur in a considerable number of the lower animals, and it seems to promise the means of greatly advancing the comprehension of the whole process of blastodermic formation. Thus *ectoderm* and *endoderm*, or the primordial rudiments of the future animal and vegetative systems of the embryo, are traced back as distinct from each other to the first stage of segmentation of the germ.

Accepting these facts as ascertained, they may be regarded as of the deepest significance in the phylogenetic history of animals; for they appear to open up the prospect of our being able to trace transitions between the earliest embryonic forms occurring in the most different kinds of ova, as between the discoid or meroblastic and the vesicular or holoblastic, through the intermediate series which may be termed amphiblastic ova.

In the lowest animals, the two layers already mentioned,

\* I ought here to refer to the elaborate memoirs of Professor Semper on the morphological relations of the Vertebrate and Invertebrate animals, contained in the *Arbeiten aus dem Zoolog.-zootom. Institut in Würzburg*, 1875 and 1876, in which the conclusions arrived at do not coincide with the views above stated.

viz., ectoderm and endoderm, are the only ones known to constitute the basis of developmental organisation; but as we rise in the scale of animals we find a new feature appearing in their structure, which is repeated also in the history of the formation of the blastoderm in the higher animals up to man. This consists in the formation of an intermediate layer or layers constituting the *mesoderm*, with which, in by far the greater number, is connected the formation of some of the most important bodily structures, such as the osseous, muscular, and vascular systems.

I will not stop to discuss the very difficult question of the first origin of the mesoderm, upon which embryologists are not yet entirely agreed, but will only remark that a view originally taken of this subject by the acute Von Baer appears more and more to gain ground; and it is this—that the mesoderm, arising as a secondary structure, that is, later than the two primary layers of ectoderm and endoderm (corresponding to the serous and mucous layers of Pander), is probably connected with or derived from both of these primitive layers, a view which it will afterwards appear is equally important ontogenetically and phylogenetically.

But whatever may be the first origin of the mesoblast, we know that in the Vertebrata this layer, separating from between the other two, and acquiring rapidly by its cell-multiplication larger proportions and much greater complexity than belongs to either ectoderm or endoderm, speedily undergoes further subdivision and differentiation in connexion with the appearance of the embryonic organs which arise from it, and in this respect contrasts greatly with the simplicity of structure which remains in the developed parts of the ectodermic and endodermic layers. Thus, while the ectoderm supplies the formative materials for the external covering or epidermis, together with the rudiments of the central nervous organs and principal sense organs, and the endoderm by itself only gives rise to the epithelial lining of the alimentary canal and the cellular part of the glands connected with it, the mesoblast is the source of far more numerous and complex parts, viz., the whole of the true skin or corium, the vertebral column and osseous system, the external voluntary muscles and connective tissue, the muscular walls of the alimentary canal, the heart and blood-vessels, the kidneys, and the reproductive organs, thus forming much the greatest bulk of the body in the higher animals.\*

There is, however, a peculiarity in the mode of the earliest development of the mesoblast which is of great importance in connexion with the general history of the disposition of parts in the animal body, to which I must now refer. This consists in the division of the mesoblast in all but its central part into two laminae, an outer or upper and an inner or lower, and the separation of these by an interval or cavity which corresponds to the space existing between the outer wall of our bodies and the deeper viscera, and which, from the point of view of the vertebrate animals is called the pleuro-peritoneal cavity, but, viewed in the more extended series of animals down to the Annuloida, may receive the more general appellation of pleuro-splanchnic or parieto-viscereal cavity, or, shortly, the *cœlom*. Thus, from an early period in the vertebrate embryo, and in a considerable number of the invertebrate, a division of the mesoderm takes place into the somatopleural or outer lamina and the splanchnopleural or inner lamina—the outer being the seat of formation of the dermal, muscular, and osseous systems (the voluntomotory of Remak), and the inner of the

muscular wall of the alimentary canal, as well as of the contractile substance of the heart and the vascular system generally.

It is interesting to find that there is a correspondence between the later division of the mesoderm of the higher animals derived from the two primitive blastodermic laminae and the original absence of mesodermic structure in the lowest animals, followed by the gradual appearance, first of one layer (the external muscular in the higher Coelenterata), and soon afterwards by the two divisions or laminae with the intermediate cœlom.

In this account of what may be termed the organised foundation of the new being, I have entered into some detail, because I felt that our conception of any relation subsisting between the ontogenetic history of animals and their phylogenetic evolution can only be formed from the careful study of the earliest phenomena of embryonic organisation. But, notwithstanding the many difficulties which unquestionably still block the way, I am inclined to think that there is great probability in the view of a common bilaminar origin for the embryo of all animals above the Protozoa, and that the vertebrate equally with the invertebrate animals may be shown to possess, in the first stages of their blastodermic or embryonic formation, the two primitive layers of ectoderm and endoderm.

To attempt, however, to pursue the history of the development of animals in detail would be equivalent to inflicting upon you a complete system of human and comparative anatomy. But I cannot leave the subject abruptly without an endeavour to point out, in the briefest possible manner, the bearing of one or two of the leading facts in embryology upon the general relation of ontogeny and phylogeny.

We are here brought into the contemplation of those remarkable changes, all capable of being observed and demonstrated, by which the complex organisation of the body is gradually built up out of the elementary materials furnished by the blastodermic layers—a process which has been looked upon by all those who have engaged in its study with the greatest interest and admiration. And if, by comparing these phenomena as observed in individuals belonging to different classes and orders of animals, it is found that not only are they not different, but, on the contrary, that they present features of the most remarkable resemblance and conformity, we shall be led to conclude that there is a general plan of development proved to extend to the members of considerable groups, and possibly capable of being traced from one group to another. But this is clearly nothing else than another way of stating that there is a similar type of structure pervading the animals of each group, and a probability of a common type being ascertained to belong to them all. The main question, therefore, to be answered is, whether there is or is not a general correspondence between the phenomena of development and the gradation of type in animal structure upon which anatomists and zoologists are agreed; and my object will now be to bring rapidly before you one or two of the most marked illustrations of the correspondence, drawn from the early history of development in the higher animals.

As one of the examples of the earlier phenomena of development I may refer to the change which is perceptible as early as the eighteenth or twentieth hour of incubation in the chick, and which is reproduced in the course of development of every member of the Vertebrate sub-kingdom. It consists in the formation of cross clefts on each side of the primitive neural cavity, which divide off from each other a number of segments of this wall in length of the axis of the embryo. At first there are only one or two such clefts; but they rapidly increase in a backward direction in the body of the embryo, and as development proceeds they extend into the tail itself. These are the *proto-vertebræ* of embryologists—not corresponding, as might at first be supposed, with the true or actual vertebræ which are formed later, but representing in an

\* If we reserve the words ectoderm and endoderm to designate the two layers of the primary bilaminar blastoderm, we may apply the terms epiblast and hypoblast to their derivatives after the formation of the mesoderm, and indicate the relations of the whole to the secondary or quadrilaminar blastoderm by the following Table:—

Primary Blastoderm	{	Ectoderm {	..... Epiblast .....	{	Secondary Blastoderm.
		Mesoderm {	Somatopleure .. Splanchnopleure		
		Endoderm {	..... Hypoblast .....		

interesting manner transverse *vertebral segments* of the body, and containing within each the elements of a great part of the structure belonging to the body-wall afterwards to be developed, including the true cartilaginous or osseous vertebral arches and the muscular plates.

This change, however, belongs to the mesodermic lamina, and occurs in an elongated thick portion of it, which makes its appearance on each side of the primitive neural canal between the epiblast and the hypoblast. The transverse cleavage is ascertained to commence near what afterwards forms the first cervical vertebra, but does not extend into the base of the cranium. And it is most interesting to note in this cleavage the formation at so early a period of the succession of *metameres* or series of similar parts, which forms a main characteristic of vertebral organisation.

As intimately connected with the formation of the vertebral column, the appearance of the chorda dorsalis or *notochord* presents many points of peculiar interest in embryological inquiries.

The notochord is a continuous median column or thread of cellular structure running nearly the whole length of the rudimentary body of the embryo, and lying immediately below the cerebro-spinal canal. It occupies, in fact, the centre of the future bodies of the vertebræ. It exists as a primordial structure in the embryo of all Vertebrates, including man himself and extending down to the *Amphioxus*, and, according to the remarkable discovery of Kowalevsky in 1866, it is to be found among the Invertebrates in the larva of the *Ascidia*.\*

In *Amphioxus* and the Cyclostomatous Fishes the notochord, growing with the rest of the body into a highly developed form, acts as a substitute for the pillar of the bodies of the vertebræ, no vertebral bodies being developed; but in Cartilaginous and Osseous Fishes various gradations of cartilaginous and osseous structures come to surround the notochord and give rise to the simpler forms of vertebral bodies, which undergo more and more distinct development in the higher Vertebrates. In all instances the substance forming the vertebral bodies is deposited on the surface of or outside the notochord and its sheath, so that this body remains for a time as a vestigial structure within the vertebral bodies of the higher animals.

The observations of Kowalevsky with respect to the existence of a notochord in the *Ascidia*, which have been confirmed by Kupfer and others, have produced a change little short of revolutionary in embryological and zoological views, leading as they do to the support of the hypothesis that the *Ascidian* is an earlier stage in the phylogenetic history of the mammal and other Vertebrates. The analogy between the *Amphioxus* and *Ascidian* larva is certainly most curious and striking as regards the relation of the notochord to other parts; and it is not difficult to conceive such a change in the form and position of the organs, in their passage from the embryonic to the adult state, as is not inconsistent with the supposition that the Vertebrates and the *Ascidia* may have had a common ancestral form. Kowalevsky's discovery opens up at least an entirely new path of inquiry; and we must be prepared to modify our views as to the entire separation of the Vertebrates from the other groups of animals, if we do not at once adopt the hypothesis that through the *Ascidian* and other forms the origin of the Vertebrates may be traced downwards in the series to the lower grades of animal organisation.

The notochord extends a short way forward into the cranial basis; and an interesting question here presents itself, beginning with the speculations of Goethe and Oken, and still forming a subject of discussion, whether the series of cranial or cephalic bones is comparable to that of the vertebræ. On the whole it appears to me that it is consistent with the most recent views of the development and anatomy of the head to hold the opinion that

it is composed of parts which are to some extent homologous with vertebral metameres.\*

The history of the formation of the vertebral column presents an interesting example of the correspondence in the development of the individual and the race, in that all the stages which have been referred to as occurring in the gradual evolution of the vertebral column in the series of Vertebrates are repeated in the successive stages of the embryonic development of the higher members of the series.

There is perhaps no part of the history of development in the Vertebrates which illustrates in a more striking manner the similarity of plan which runs through the whole of them than that connected with what I may loosely call the region of the face and neck, including the apparatus of the jaws and gills. The embryonic parts I now refer to consist of a series of symmetrical pairs of plates which are developed at an early period below the cranium, and may therefore, in stricter embryological terms, be styled the *subcranial plates*.

Without attempting to follow out the remarkable changes which occur in the development of the nose and mouth in connexion with the anterior set of these plates (which, from being placed before the mouth, are sometimes named *pre-oral*), I may here refer shortly to the history of the plates situated behind the mouth, which were discovered by Rathke in 1826, and formed the subject of an elaborate investigation by Reichert in 1837.

These plates consist of a series of symmetrical bars, four in number in mammals and birds, placed immediately behind the mouth, separated by clefts passing through the wall of the throat, and each traversed by a division of the great artery from the heart—thus constituting the type of a branchial apparatus, which in fishes and Amphibia becomes converted into the well-known gills of these animals; whilst in reptiles, birds, and mammals they undergo various changes leading to the formation of very different parts, which could not be recognised as having any relation to gill-structure, but for the observation of their earlier embryonic condition. The history of this part of development also possesses great interest on account of the extraordinary degree of general resemblance which it gives to the embryos of the most different animals at a certain stage of advancement (so great, indeed, that it requires a practised eye to distinguish between the embryos of very different orders of mammals, and even between some of them and the embryos of birds or reptiles), as well as in connexion with the transformations of the first pair of branchial apertures, which lead to the formation of the passage from the throat to the ear in the higher Vertebrata. There is equal interest attached to the history of the development of the first pair of arches, which include the basis of formation of the lower jaw with the so-called *cartilage of Meckel*, and which, while furnishing the bone which suspends the lower jaw in reptiles and birds, is converted in mammals into the hammer-bone of the ear.

The other arches undergo transformations which are hardly less marvellous, and the whole series of changes is such as never fails to impress the embryological inquirer with a forcible idea of the persistence of type and the inexhaustible variety of changes to which simple and fundamental parts may be subject in the process of their development.

It is also of deep significance, in connexion with the foregoing phenomena, to observe the increase in the number of the gill-bars and apertures as we descend in the scale to the cartilaginous fishes and lampreys, and the still further multiplication of these metameres or repeated parts in the *Amphioxus*; and it is, perhaps, also interest-

\* *Mém. de l'Acad. de St. Pétersbourg*, vol. x.

\* See the interesting and valuable memoirs of W. K. Parker, "On the Anatomy and Development of the Vertebrate Skull," in *Trans. of Roy. Soc.*, the researches of Gegenbaur, Mihalkovics, and more particularly the memoir by F. M. Balfour, "On the Development of the Elasmobranchs," in the *Journ. of Anat. and Physiol.*, vols. x. and xi.

ing to note that in the *Ascidia* the arrangement of the gills is exactly similar to that of the *Amphioxus*.

The study of the comparative anatomy of the heart and its mode of formation in the embryo furnishes also most striking illustrations of the relation between ontogenetic and phylogenetic development in the Vertebrates, and is not without its applications to some of the invertebrate groups of animals.

I need only recall to your recollection the completely double state of this organ in warm-blooded animals, by which a regular alternation of the systematic and pulmonary circulations is secured, and the series of gradations through the class of Reptiles by which we arrive at the undivided ventricle of the amphibian, and the further transition in the latter animals by which we come at last to the single heart of fishes; and to state that in the embryo of the higher animals the changes by which the double heart is ultimately developed out of an extremely simple tubular form, into which it is at first moulded from the primitive formative cells, are, in the inverse order, entirely analogous to those which I have just now indicated as traceable in the descending series of vertebrate animals; so that at first the embryonic heart of man and other warm-blooded animals is nothing more than a rhythmically contractile vascular tube. By the inflection of this tube, the constriction of its wall at certain parts, and the dilatation at others, the three chambers are formed which represent the single auricle, the single ventricle, and the aortic bulb of the fish. By later changes a septum is formed to divide the auricles, being completed in all the air-breathing animals, but remaining incomplete in the higher animals so long as the conditions of foetal life prevent the return of arterialised blood to the left auricle. The growth of another septum within the ventricular portion gradually divides that cavity into two ventricles, repeating somewhat in its progress the variations observed in different reptiles, and attaining its complete state in the crocodile and warm-blooded animals.

I must not attempt to pursue this interesting subject further; but I cannot avoid making reference to the instructive view presented by the embryological study of the nature of the malformations to which the heart is subject, which, as in many other instances, are due to the persistence of transitory conditions which belong to different stages of progress in the development of the embryo. Nor can I do more than allude to the interesting series of changes by which the aortic bulb, remaining single in fishes and serving as the channel through which the whole stream of blood leaving the heart is passed into the gills, becomes divided in the higher animals into the roots of the two great vessels, the aorta and the pulmonary artery, and the remarkable transformation of the vascular arches which proceed from the aortic bulb along the several branchial arches, and which, in the gills of fishes and aquatic Amphibia undergo that minute subdivision which belongs to the vascular distribution of gills, but which in the higher non-branchiated animals are the subject of very different and various changes, in the partial obliteration of some and the enlargement of others, by which the permanent vessels are produced.

These changes and transformations have for many years been a subject of much interest to comparative anatomists, and will continue to be so, not only from their presenting to us one of the most remarkable examples of conformity in the plan of development and the type of permanent or completed organisation in the whole series of vertebrate animals, but also because of the manifest dependence of the phenomena of their development upon external influences and atmospheric conditions which affect the respiration, nutrition, and modes of life of the animal.

Nor is the correspondence to which I now refer entirely limited to the Vertebrata. For here, again, through the *Amphioxus* and the *Ascidia*, we come to see how an affinity may be traced between organs of circulation and respiration which at first appear to belong to very different

types. The heart of vertebrates is, as is well known, an essentially concentrated form of vascular development in the ventral aspect of the body, while the heart of the invertebrate, whether in the more concentrated form existing in the Articulata and Mollusca, or in a more subdivided shape prevalent in the Annelida, is most frequently dorsal; yet the main aorta of the Vertebrates is also dorsal; and it is not impossible, through the intermediate form of *Amphioxus*, to understand how the relation between the Vertebrate and the Invertebrate type of the blood-vascular system may be maintained.

But I am warned by the lapse of time that I must not attempt to pursue these illustrations further. In the statement which I have made of some of the more remarkable phenomena of organic production—too long, I fear, for your endurance, but much too brief to do justice to the subject—it has been my object mainly to show that they are all more or less closely related together by a chain of similarity of a very marked and unmistakable character; that in their simplest forms they are indeed, in so far as our powers of observation enable us to know them, identical; that in the lower grades of animal and vegetable life they are so similar as to pass by insensible gradations into each other; and that in the higher forms, while they diverge most widely in some of their aspects in the bodies belonging to the two great kingdoms of organic nature, and in the larger groups distinguishable within each of them, yet it is still possible, from the fundamental similarity of the phenomena, to trace in the transitional forms of all their varieties one great general plan of organisation.

In its simplest and earliest form that plan comprises a minute mass of the common nitrogenous hydrocarbon compound to which the name of protoplasm has been given, exhibiting the vital properties of assimilation, reproduction, and irritability. The second stage in this plan is the nucleated and enclosed condition of the protoplasmic mass in the organised cell. We next recognise the differentiation of two productive elements, and their combination for the formation of a more highly endowed organising element in the embryonic germ-sphere or cell; and the fourth stage of advance in the complexity of the organising phenomena is in the multiplication of the fertilised embryo-cell and its conversion into continuous organised strata, by further histological changes in which the morphological foundations of the future embryo or new being are laid.

I need not now recur to the further series of complications in the formative process by which the bilaminar blastoderm is developed and becomes trilaminar or quadrilaminar, but only recall to your recollection that while these several states of the primordial condition of the incipient animal pass insensibly into each other, there is a pervading similarity in the nature of the histological changes by which they are reached, and that in the production of the endless variations of form assumed by the organs and systems of different animals in the course of their development, the process of cell-production, multiplication, and differentiation remains identical. The more obvious morphological changes are of so similar a character throughout the whole, and so nearly allied in the different larger groups, that we are led to regard them as placed in some very close and intimate relation to the inherent properties of the organic substance which is their seat, and the ever-present influence of the vital conditions in which alone these properties manifest themselves.

The formative or organising property therefore resides in the living substance of every organised cell and in each of its component molecules, and is a necessary part of the physical and chemical constitution of the organising elements in the conditions of life; and it scarcely needs to be said that these conditions may be as varied as the countless numbers of the molecules which compose the smallest particles of their substance. But, setting aside all speculation of a merely pangenetic kind, it appears to

me that no one could have engaged in the study of embryological development for any time without becoming convinced that the phenomena which have been ascertained as to the first origin and formation of textures and organs in any individual animal are of so uniform a character as to indicate forcibly a law of connexion and continuity between them; nor will his study of the phenomena of development in different animals have gone far before he is equally strongly convinced of the similarity of plan in the development of the larger groups, and, to some extent, of the whole. I consider it impossible, therefore, for any one to be a faithful student of embryology, in the present state of science, without at the same time becoming an evolutionist. There may still be many difficulties, some inconsistencies, and much to learn, and there may remain beyond much which we shall never know; but I cannot conceive any doctrine professing to bring the phenomena of embryonic development within a general law which is not, like the theory of Darwin, consistent with their fundamental identity, their endless variability, their subjugation to varying external influences and conditions, and with the possibility of the transmission of the vital conditions and properties, with all their variations, from individual to individual, and, in the long lapse of ages, from race to race.

I regard it, therefore, as no exaggerated representation of the present state of our knowledge to say that the ontogenetic development of the individual in the higher animals repeats in its more general character, and in many of its specific phenomena, the phylogenetic development of the race. If we admit the progressive nature of the changes of development, their similarity in different groups, and their common characters in all animals—nay, even in some respects in both plants and animals—we can scarcely refuse to recognise the possibility of continuous derivation in the history of their origin; and however far we may be, by reason of the imperfection of knowledge of Palæontology, Comparative Anatomy, and Embryology, from realising the precise nature of the chain of connexion by which the actual descent has taken place, still there can be little doubt remaining in the mind of any unprejudiced student of embryology that it is only by the employment of such an hypothesis as that of Evolution that further investigation in these several departments will be promoted, so as to bring us to a fuller comprehension of the most general law which regulates the adaptation of structure to function in the Universe.

At the conclusion of the Address a vote of thanks to the President was proposed by the EARL OF MOUNT EDGUMBE, seconded by Dr. HENRY ACLAND, and carried by acclamation.

## ADDRESS TO THE CHEMICAL SECTION

BY

Professor ABEL, F.R.S., &c.,  
President of the Section.

THE subject which my predecessor in the honourable position of President of this Section made the chief topic of his interesting and instructive Address, affords excellent illustrations of the operation of purely scientific research in creating and developing important branches of industry. Mr. Perkin, whose name has from the very commencement of the history of coal-tar colours been identified with their discovery and their scientific and technical history, referred to several series of researches, each one of which formed a link in a chain of discoveries in organic chemistry, of the highest value as establishing, illustrating, or extending important chemical theories, but, at the time and for long afterwards, of value purely from a scientific point of view. These researches, undertaken and pursued

by ardent and philosophical investigators under more or less formidable difficulties and solely in the interests of Science, resulted in the discovery of certain organic bodies which were produced originally only on a very small scale and at great cost, but which, after the lapse of years, have been readily manufactured from abundant sources, and have constituted important elements in the development of the industry of artificial colouring-matters. In fact this industry—which owes its origin to the discovery of mauve by Mr. Perkin, about twenty years ago, and which is second to no branch of chemical industry in regard to the rapidity of its development and its influence upon other important branches of manufacture—affords more copious illustrations than any other of the immediate influence of pure science upon industrial progress. It therefore affords a topic which the chemist may well be excused for continually recurring to, with an interest bordering on enthusiasm, when illustrating the material advantages which accrue to communities from the promotion of scientific training and the encouragement of chemical research.

The iron and steel industry presents a great contrast to that of the artificial colours, in regard to the extent of influence which the labours of purely scientific investigators have exerted upon its development. The efforts of scientific men to unravel such problems as, for instance, the true chemical constitution of steel, or the precise differences between the various combinations known as cast-iron, and the conditions which determine their individual production or conversion from one to another, have hitherto been attended by results not at all proportionate to the patient experimental investigation of which from time to time they have been made the subject. Thus the protracted experiments and discussion carried on by Frémy and Caron some years back, with reference to the dependence of the characteristics of steel upon the existence in it of nitrogen, cannot be said to have led to results of a more conclusive or even definite nature, regarding the conditions which regulate the production, composition, and properties of steel than those arrived at by previous distinguished experimentors; and the same may be said, with respect to cast-iron, of such experiments as those carried on for several years by Matthiessen (in which I also took some part), under the auspices of the Association, with the view to eliminate many existing points of doubt regarding the chemical constitution of cast-iron, by preparing chemically pure iron and studying its combinations with carbon and other elements occurring in cast-iron.

The prosecution of purely scientific investigation may, therefore, of itself fail to bear *direct* fruit in regard to the development of new metallurgic achievements, or even to the elucidation of the comparatively complicated and numerous reactions which occur in furnaces, either simultaneously or in rapid and difficultly controllable succession, between materials composed of a variety of constituents in variable proportions. There can, however, be no question regarding the important benefits which have accrued from the application of chemical knowledge to the study, and the perfection of furnace-operations by those who happily combine that knowledge with practical experience and with the power of putting to the test of actual practice the results of reasoning upon an intelligent observation of the phenomena exhibited in such operations, and upon the data which chemical analysis has furnished. In the hands of such men, the scientific results arrived at by Karsten, Berthius, Bunsen, Scheerer, Percy, and other eminent investigators, acquire new value, and by them the fruits of the labours of the patient toiler at analytical processes meets with that appreciation which their solid and permanently valuable work does not always command at the hands of their numerous brother-workers in chemical science who follow the far more attractive paths of organic research.

Naturally, the brilliant results achieved from time to time by investigators in organic chemistry,—the rapidity with which, by those results, theories are established or

extended, types founded, their offspring multiplied, and their connection with other families traced and developed,—impart to organic research a charm peculiarly its own. This, and the general ease with which new results are obtained by the pursuit of methods of research comparatively simple in their nature and few in kind, have for many years not only secured to organic chemistry an overwhelming majority of workers—they also appear to have had a tendency to lead the younger labourers in the field of organic research to under-estimate the value and importance, in reference to the advancement of science, of the labours of the plodding investigator of analysis. Yet no higher example can be furnished of the patient pursuit of scientific work, purely for its own sake, than that of the deviser or improver of analytical processes, who, undeterred by failure upon failure, indefatigably pursues his laborious work, probing to its foundation each possible source of error, carefully comparing the results he obtains with those furnished by other methods of analysis, and patiently accumulating experimental data, till they suffice fully to establish the value and trustworthiness of the process, which he then publishes for the benefit of his fellow-workers in Science. Truly the results of such labours do not stand in unfavourable contrast, from whatever light they may be viewed, to those of the investigator of organic chemistry. It is not to be denied that the labourer at organic research may—so far as the analytical work which should fall to his share in the course of his investigations is concerned—be tempted to reduce this, the least attractive portion of his work, to within the smallest possible limits, and having, for example, by a boiling-point determination, or a single analytical operation of the simplest kind, such as the examination of a platinum-salt, obtained a numerical result approximating to that which his theory demands, may hasten on to the further development of his airy structure, possibly not without risk to its stability. Unquestionably there are instances of frequent occurrence, in the pursuit of a particular line of organic research, in which more is not required than the identification of a particular product by some such simple means as above indicated: it is certain, moreover, that the labours of the organic investigator also not unfrequently afford bright examples of indomitable perseverance under formidable difficulties; and this alone should constitute a strong bond of union between the worker in organic research and his brother-worker in analytical chemistry, if one did not already exist in the active interest which each—if a true lover of Science—must take in the work of the other.

It has been remarked by one of the most distinguished investigators, and at the same time one of the most brilliant lecturers and successful teachers of our time, that the contrivance of a new and good lecture-experiment may rank in importance with the preparation of a new organic compound, and it may certainly be said, with equal truth, that the elaboration of a new and good method of analysis may rank in importance with a good research in organic chemistry, in reference both to the part it plays in the advancement of science and to its influence upon industrial progress.

An excellent illustration of this is afforded by reference to the Proceedings of the British Association when it met in this town thirty-six years ago. In a letter to Dr. Playfair, Liebig—who took a very active part in the proceedings of the Association in the earlier years of its existence—reports that Drs. Will and Varrentrapp have devised an excellent method for determining the amount of nitrogen in organic bodies, “very exact and easily performed.” He then describes, in a few lines, the process so well known to chemists, which not only has been and continues to be invaluable to those engaged in organic research, but which, as may be testified by such researches as those of Lawes and Gilbert, has borne a most important and indispensable part in the advancement of agricultural chemistry. It is, I believe, but an expression of the unanimous conviction of chemists to say that the achieve-

ments in analytical chemistry of such men as Berzelius, Heinrich, Rose, and Fresenius take equal rank with the brilliant researches and theoretical expositions of such chemists as Liebig, Laurent, Gerhardt, and Berthelot: and that, of all the important contributions to the development of organic chemistry which we owe to Liebig, there is none which has exerted so great an influence on the progress of this branch of chemical science as his beautifully simple method of organic elementary analysis.

Reverting to the industry of iron and steel, which, in regard to some of its most important branches, cannot fail to be a subject of special interest in Plymouth and Devonport, it is not difficult to demonstrate that the labours of the analytical chemist have exercised and continue to exert an important influence on the very considerable advance which has in recent years been made, and still proceeds, towards securing complete control over the quality and character of the products obtained. The epoch is well within the recollection of chemists of my generation when the British iron-master first awoke to the benefits which might accrue to him from an application of the labours of the analytical chemist in connection with iron smelting.

When the last great stride was made in the manufacture of cast-iron, by the introduction of the hot blast, the iron smelter was naturally led to seek profit, to the fullest extent, with respect both to the great increase in the rate of production of pig-iron attainable thereby, and to the economy achievable in regard to the proportions and characters of the materials employed in the production of pig-iron. But, after a time, the great falling off in the quality of a large proportion of the products of the blast-furnace, and the difficulties experienced in the production of malleable iron of even very moderate quality, aided by the great impetus to competition in respect of quality given by the first International Exhibition in 1851, directed the attention of our more enlightened iron-masters to the likelihood of their deriving important aid from chemical science, and more especially from the investigations of the analytical chemist.

Among the earliest to realise the importance of trustworthy and detailed information regarding the composition of the iron ores of the country was Mr. S. H. Blackwell, who, in presenting to the Royal School of Mines a very extensive and interesting series of British ores which he had collected with great labour and expense, for exhibition in 1851, placed at the disposal of Dr. Percy the requisite funds for engaging the services of competent analysts (Messrs. J. Spiller and A. H. Dick), who, under his direction, and with subsequent pecuniary aid from himself and from Government funds, carried out a very careful and complete examination of this series, the results of which have been of great value, for purposes of reference, to those actively interested in the iron industry. It was, however, the first connection of Messrs. Nicholson and D. S. Price, and of Mr. E. Riley, with two of the most important iron-works of this country, about a quarter of a century ago (*i.e.*, at the time when the above investigation was commenced), that marked, I believe, the commencement of systematic endeavours to apply the results of analytical research to the improvement and regulation of the quality of the products of our iron-works.

It is perhaps but natural that the primary object sought, by application of the knowledge of the analytical chemist, should have been to eliminate or reduce the existing elements of uncertainty in obtaining the most abundant yield of pig-iron capable of conversion into railway bar sufficiently good to meet the minimum standard of quality, and to reduce still further the cost of production of such bar-iron by utilising materials concerning the composition of which (richness in iron, &c.) the iron smelter was completely in the dark. The information accumulated by the analyst respecting the composition of the ores, fuel, and fluxes available at the works, and the composition of the pig-iron and slags or cinders, produced under varied conditions, in regard to materials employed and to the pro-

portions of ore, fuel, and flux used in the blast furnace, could not, however, exist long without exerting a marked beneficial influence upon the quality of iron produced, and generally upon the iron industry of the country.

Percy's invaluable work of reference on metallurgy furnishes abundant evidence of the scientifically interesting as well as practically useful nature of the results obtained at that time by the chemist above named, and others, working under Dr. Percy, with respect both to the elaboration of important analytical processes (in which direction Mr. Riley has continued to the present day to do valuable work) and to the elucidation of the reactions occurring in the processes of reduction and refining of the metal. It is needless to dwell upon the fact that the aid of the analyst has now long since become absolutely indispensable to the iron and steel manufacture, but I may perhaps be allowed briefly to refer to one or two recent illustrations of the indispensable part which analytical research has played, and continues to play, in the extension of our knowledge of the chemical reactions involved in the production of cast- and wrought-iron and of steel, and of the influences which the chief associates of iron, in its mercantile forms, exert upon its physical characters.

Among the many valuable communications made to that most important body, the Iron and Steel Institute of Great Britain, by men who combine great practical knowledge and experience in iron and steel manufacture with high attainments in mechanical science, and such knowledge of chemical science as ensures a full appreciation of its value at their hands, one of the most interesting and suggestive to the chemist, is that on the separation of carbon, sulphur, silicon, and phosphorus in the refining and puddling furnace and in the Bessemer converter, contributed to the *Transactions* of the Institute's recent meeting by Mr. Lowthian Bell, whose valuable investigations in connection with the iron industry are as interesting to the chemist as they are useful to the manufacturer. Mr. Bell has brought together the results of an extensive series of practical experiments on the treatment of different kinds of pig-iron of known composition, in the refinery, the puddling furnace, and the Bessemer converter, and by comparing the results of analytical investigation of the products of those experimental operations with each other and with those of the materials operated upon, he has obtained valuable confirmation of the views already held by metallurgic chemists regarding the succession in which carbon, silicon, sulphur, and phosphorus are attacked when pig-metal is submitted to the above purifying processes, and the extent to which those foreign associates of iron are abstracted, or resist removal by the more or less thorough application of those several modes of treatment. He has also thrown new light on the reasons why the most difficultly assailable impurity, phosphorus, obstinately resists all attempts to effect even a slight diminution in its amount by application of the Bessemer treatment. The earnestness with which Mr. Bell wages war against this enemy of the iron master, in one of its most favourite haunts, the Cleveland district, not simply with the old British pluck which acknowledges not defeat, but systematically, on scientific principles, calling to his aid all the resources which the continual advances in applied mechanical and chemical research place within his reach, cannot fail to contribute importantly, if it does not of itself directly lead, to the complete subjection of this most intractable of the associates to which iron becomes linked in the blast furnace. Indications have lately not been wanting that the existence of phosphorus in very notable proportion in iron may not of necessity be inimical to its conversion into steel of good quality, and it may be that this element, which is now turned to useful account to impart particular characteristics to the alloys of copper and tin, is even destined to play a distinctly useful part in connection with the production of steel possessed of particular characters, valuable for some special purposes.

In the great development which steel manufacture has

received within the last few years, one most prominent feature has been the production with precision upon a large scale of steel of desired characteristics, in regard to hardness, &c., by first adding to fluid cast-iron of known composition the requisite proportion of a rich iron ore (with or without the addition of scrap-iron) to effect a reduction of the carbon to the desired amount, concurrent with a refining of the metal by the oxidising action of the ore, and then giving to the resulting steel the desired special qualities by the addition of suitable proportions of iron compounds of known composition rich in manganese and carbon (Spiegeleisen and the similar product called ferro-manganese). The germ of this system of producing steel varieties of predetermined characteristics, exists in crucible processes like that of Uchatius, which have been in more or less extensive use for many years past, but it is to such invaluable arrangements as are most prominently represented by the Siemens-Martin furnace, whereby several tons of metal may be fused and maintained at a very high temperature with as little liability to change, from causes not under control, as if the operation were conducted in a crucible, that we are indebted for the very great expansion which the direct application of the analytical chemist's labours to the development of the steel industry is now receiving.

The production of steel upon the open hearth, to the elaboration of which Dr. C. W. Siemens has so largely contributed, since he first established the process at Llandore in 1868, has, in fact, become assimilated in simplicity of character and precision of results to a laboratory operation, and may be justly regarded as a triumph of the successful application of chemical principles and of the power of guidance and control afforded by utilising analytical research, to the attainment of prescribed results upon a stupendous scale, with an accuracy approaching that which the experienced chemical operator secures in the laboratory upon a small scale, under conditions which he can completely control. The production of steel by a large number of small separate operations in pots has now become supplanted with great advantage by the Siemens-Martin system of working at some of our largest establishments at Sheffield; this system has also secured a footing at highly renowned Continental works, which are formidable competitors with us in the manufacture of steel, such as those of Essen, Creusot, and Têrrenoire. It is specially interesting to notice that, in the hands of those who, on the Continent at least, equally with ourselves, have learned to combine the results of practical experience with the teachings of chemical science, the facilities now existing for dealing in a single receptacle with large masses of fluid steel have greatly facilitated the application of chemical means to the production of *solid* masses of considerable size, thereby reducing, if not altogether dispensing with, the necessity for submitting large steel castings to costly mechanical operations, with the object of closing up cavities caused by the escape of occluded gas as the liquid metal cools. The success in this direction which appears to have attended the addition of silicon in combination with iron and manganese to the steel before casting, in preventing the formation of so-called *blow-holes*, and in contributing at the same time to the production of the particular character of steel required, bids fair to be of special importance in connection with the application of steel to the production of projectiles for use against armour-plates, as affording ready, and comparatively very economical, means of ensuring the production of perfectly sound castings, which, in compactness of structure will, it is asserted, compete successfully with carefully forged castings, and even with the magnificent material which Whitworth produces by submitting the fluid metal to powerful pressure.

The part which silicon plays, by its comparatively high susceptibility to oxidation, in promoting the production of sound steel castings is readily intelligible, but the functions of the manganese compounds, which are an indispensable adjunct to the Bessemer process, and the application of

which has become an integral part of steel manufacture, are still far from being thoroughly understood, and there is ample scope for chemical research, in co-operation with practical experiment, in the further study of the influence, not only of manganese in the production, and upon the properties, of steel, but also of elements such as titanium, tungsten, and boron, and of chromium, which exists associated in considerable quantities with iron in a very abundant Tasmanian ore, to which prominent attention has lately been directed. The achievements of the mechanical engineer have so facilitated the handling and perfected the means of production and the mechanical treatment of malleable iron and of steel, that the full advantage may now be reaped of any improvements of a chemical nature which may be affected in the production of those materials; and it must be a source of pride to the chemist to observe with what success the teachings of his science are being applied by practical men of the present day in the construction of furnaces capable of withstanding the high temperatures required for the production and working of iron and steel in large masses, and in combining the perfect consumption, and consequent great economy of fuel, with the attainment of those high temperatures, and with a thorough control over the character of the gaseous agents to which the fluid metal is exposed in the furnaces. I need not quote the names of those men who have already rendered themselves prominent by their services in this particular direction, but may refer, in special illustration of the results achieved by purely practical men, to the success in applying very simple furnace arrangements to the attainment of the above results which has recently attended the labours of Mr. William Price, a principal foreman in the Royal Gun Factories at Woolwich.

A few experiments made in the early days of the application of armouring to ships and forts appeared to demonstrate, on the one hand, that steel was quite incapable of competing with malleable iron, of even very moderate quality, as a material for armour plates; and, on the other hand, that the penetrative power of projectiles made of chilled iron upon the Palliser system could not be surpassed, or even attained with any degree of certainty, by projectiles of steel, produced at comparatively very great cost. But some recent results obtained on the Continent, and especially in the course of the important experiments instituted by the Italian Government at Spezzia, have afforded decisive indications that steel—the application of which to the construction of ordnance has since that time been very greatly extended—may now be looked to hopefully as capable of affording greater protection against the enormous projectiles of the present day than can be secured by proportionately large additions to the stupendous iron-armouring of the most modern ironclads, and also applicable, at a cost very moderate when compared with that of ten years ago, to the production of projectiles of large dimensions, superior in point of penetrative power, and of uniformity in this respect, to those of chilled iron, the difficulties in the production of which are very greatly increased by the formidable increase which has lately been made in their size. Promising results have also quite recently been obtained at Shoeburyness with a new system of applying steel in conjunction with malleable iron, by which a perfect union of masses of the two materials at one of their surfaces is effected by the aid of heat.

The superiority of soft and very homogeneous steel over wrought-iron of the best quality, in regard to lightness combined with strength and toughness, are leading to its very advantageous employment in the construction of a particular class of vessels for the Navy; and the perfect confidence which can be placed in the uniformity, in structure and strength, of steel of such character as is produced by the Whitworth system of manufacture, has greatly facilitated the production of air-chambers of small weight, but capable of being quite safely charged with sufficient air (under the pressure of 1000 lbs. on the square inch) to carry the Whitehead torpedo through water to a

distance of 1000 yards in little more than a minute and a half.

Thus, the results of the recent development of steel industry, to which the labours of the chemist have not unimportantly contributed, give promise of exerting a great influence upon the resources of nations for defence and attack. Although the necessity for the continual expansion of such resources cannot but be deeply deplored, there can be no doubt that the problems which it presents, and the special requirements to which it gives rise, must operate, and perhaps as importantly as the demands created by peaceful industries and commercial enterprise, in encouraging the metallurgist, the chemist, and the engineer to continue their combined work in following up the successes, to the achievement of which the results of scientific research have greatly, though indirectly, contributed.

If it were necessary to add to the illustrations which Mr. Perkin gave in his address last year of the practical fruits of research in *organic* chemistry, I might be tempted to dilate upon the important results which have, especially during the last ten years, grown out of the discovery and study of the products of the action of nitric acid upon cellulose and glycerine. During the six years which have elapsed since I had the honour of bringing before the members of the British Association the chief points of scientific interest and practical importance presented by the history of those remarkable bodies, their application to technical and war purposes has been greatly developed. Nitro-glycerine gun-cotton may now be justly classed among the most interesting examples of the practical importance frequently attained by the results of chemical research, while the history of the successive steps by which their safe manipulation and efficient application have been developed affords more than one striking illustration of the achievements effected, by combined chemical and physical research, in the solution of problems of high scientific interest and practical importance, and in the vanquishment of difficulties so formidable as for a time to appear fatal to the attainment of permanently practical success.

It is to a careful study of the influence which the *principal* character of gunpowder (its density, hardness, &c.), and its *mechanical* condition (*i.e.*, form and size of the masses and condition of their surfaces) exert upon the rapidity of its explosion under confinement, that we chiefly owe the very important advance which has been made of late years in controlling its explosive force, in its applications as a propelling agent, and the consequent simple and effectual means whereby the violence of action of the enormous charges now used in siege- and ship-guns is effectually reduced to within their limits of endurance without diminution of the total explosive force developed. But, concurrently with these important practical results, the application of combined chemical and physical research to a very extended and comprehensive investigation of the action of fired gunpowder, has furnished results which possess considerable interest from a purely scientific point of view, as in many respects modifying, in others supplementing, the conclusions based upon earlier experiments and theoretical considerations with respect to the nature and proportions of the products formed, the heat developed by the explosion, the tension of the products of combustion, and the conditions which regulate it, both when the explosion is brought about in a close vessel and when it occurs in the bore of a gun. The results of these physico-chemical researches have, moreover, already acquired practical importance in regard to the light they have thrown upon the influence exerted by variable conditions of a mechanical nature upon the action of and pressure developed by fired gunpowder in the bore of a gun, and in demonstrating that modifications in the *composition* of gunpowder, not unimportant from an economical point of view in dealing with the very large charges now employed, may importantly contribute to render the storing of the maximum of work in the projectile, when

propelled from a gun, compatible with a subjection of the gun to comparatively very moderate and uniform strains.

Other interesting illustrations of the intimate manner in which physical and chemical research are linked together, and of the important extent to which some of our most illustrious workers in chemistry have contributed to demolish the semblance of a barrier which existed in past times between the two branches of science, are furnished and suggested in the recently published Lists of Grants of Money which the Government has made to scientific men, on the recommendation of the Royal Society, from the fund which for the first time last year was added to the very modest sum previously accorded from national resources in support of research. The perusal of that list, representing as it does a most carefully considered selection by the highest representatives of science in the country, from a very large number of applications, affords important evidence on the one hand of the active pursuit of science in Great Britain, and, on the other, of the very wide range of subjects of interest and importance, the full investigation of which demands the provision of adequate resources. That the necessity for such resources needs but to be thoroughly made known to ensure their provision, even from other than national sources, has been demonstrated by the success which, in a comparatively brief space of time, has attended the efforts of the Chemical Society to establish upon the foundation patriotically laid by one of its original members, Dr. Longstaff, a special fund, to be administered by the Society, for the advancement of chemical science. An inspection of the list of contributors to this special fund in aid of chemical research, which in about two years has reached the sum of £4000, and from the proceeds of which the first applications for grants have recently been met, is suggestive of two observations. One is, that the proportion and amount of contributions hitherto received are comparatively small from the source whence the greatest support of such a fund may naturally be looked for, namely, from those who most directly benefit by the results of chemical research. It is to be hoped that there are many prominent representatives of the chemical and metallurgical industries in this country who still intend to give practical effect to their natural desire to aid in the advancement of chemical science, and to the appreciation which they can hardly fail to entertain of the usefulness of this fund. On the other hand, it is a matter well meriting special notice that a very prominent section of the contributors to the fund is composed of some of the most ancient corporate bodies of the City of London. Most welcome evidence is thereby afforded of the readiness with which the City Companies are prepared to respond to appeals for the substantial support of measures well calculated to promote progress in science. This evidence, and the combined action which they are even now contemplating for promoting the application of scientific research to the advancement of industry and commerce, by establishing an institution for technical education upon a scale worthy to serve as a monument of the true usefulness of wealthy corporations, must be cordially hailed as very substantial proofs that these representatives of our national wealth and commercial supremacy are entering upon a new sphere of activity which will more than restore their ancient prestige, by according them a new rank, more elevated than any which their civic importance could, in the past or future, confer upon them—a rank high among the chief promoters of our national enlightenment.

Preservation of Wine.—Prof. J. Nessler.—Two parts per cent of salicylic acid are mixed with melted paraffin, and small chips of wood or linen rags are saturated with the mixture and thrown into the casks, where they kill the organisms which promote the formation of vinegar.—*Moniteur Scientifique*.

## PROCEEDINGS OF SOCIETIES.

AKADEMIE DER WISSENSCHAFTEN, VIENNA.

June and July, 1877.

L. LIPÖCZ, "*Determination of Water in Silicates*." The powdered mineral is mixed with sodic carbonate at 60°, placed in a platinum boat, and inserted in a well-dried porcelain tube. The latter is then heated in an ordinary combustion-furnace until the silicate is completely fused, and the expelled water is driven into a calcic chloride tube by a stream of dry air. The process has been thoroughly tested, and gives satisfactory results.

A. BAUER and H. SCHULER, "*New Formation of Pimelic Acid*." This acid can be prepared by the action of potassic hydrate and potassic cyanide on amylen-bromide.

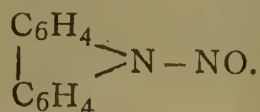
S. ZEISEL, "*Action of Sulphuric Acid on Acetylen*." This reaction, according to Berthelot, causes the formation of an acetylen alcohol. The author shows contemporaneously with Lagermarck and Eltekoff (CHEMICAL NEWS, xxxv., 163) that no alcohol but croton aldehyd results from the reaction, and that the formation of the latter is due not to the acetylen itself, but to the presence of vinyl bromide as an impurity.

L. V. BARTH and H. WEIDEL, "*Action of Hydrochloric Acid on Resorcin*." The reaction yields two compounds, which are to be regarded as ether derivatives of resorcin. One results from the condensation of 2 molecules accompanied by the separation of 1 molecule H<sub>2</sub>O. The other results from the condensation of 4 molecules, accompanied by the elimination of 4 molecules H<sub>2</sub>O. The two are separated by means of the varied solubilities of the lead salts. Both are amorphous, dichroitic, and impart a brilliant fluorescence to alkaline solutions, a property serving as a reaction for resorcin. Fusion with potash yields resorcin. Oxidation causes the formation of small quantities of picric acid and isophthalic acid.

J. PULUJ, "*On the Radiometer*." The author has constructed a radiometer, in which four disks of mica, blackened on one side with soot, are attached to two immovable beams at right angles to each other, and enclosed by a cube consisting of mica plates, which is lightly balanced on a vertical needle-point. Experiment showed that the cube rotated in exactly the opposite direction from that in which the disks would have moved if they had not been stationary. This fact would tend to show that action and reaction exist between the movable and stationary parts of the radiometer, and hence that inner forces are the source of the motion. The experiment shows, also, that a gaseous medium is necessary for the transmission of kinetic energy from one portion of the apparatus to another. Meyer's explanation of the movement of the disks in the radiometer, as resulting from the friction of the air on their edges, must be false, for it would require the cube to move in the same direction as the disks.

J. KACHLER, "*Compounds in the Camphor Group*." Oxidation of camphor with HNO<sub>3</sub> yields, besides the known acids, camphoric acid, meso-camphoric acid, camphoronic acid, and dinitro-heptylic acid, four new compounds, hydro-oxy-camphoronic acid, C<sub>9</sub>H<sub>14</sub>O<sub>6</sub>, crystallising well, and forming mono-, di-, and tribasic salts, and three acids of analogous composition. Mono- and dinitro-heptylic acids are changed by reduction into methyl-isopropylketon.

O. ZEIDLER, "*Substances Accompanying Crude Anthracen*." The author describes those which are soluble in acetic ether. They consist of carbazol, phenanthren, fluoren, and two new hydrocarbons, pseudo-phenanthren, C<sub>16</sub>H<sub>12</sub>, and synanthren, C<sub>14</sub>H<sub>10</sub>. An easy method of separating carbazol from crude anthracen is described. The author has shown the formula of carbazol to be (C<sub>6</sub>H<sub>4</sub>)<sub>2</sub>NH, by preparing the nitroso derivative—



"Action of Chloral Hydrate on Camphor." By rubbing together molecular weights of the two substances a clear liquid is obtained, which does not crystallise even at  $-20^\circ$ , and is decomposed at once by water into the original substances. The specific rotatory power— $10^\circ$  less than that of camphor in various solvents—and other properties would tend to show it to be a molecular compound, and not a solution. Chloral ethylate acts in the same manner.

## NOTICES OF BOOKS.

*Fownes's Manual of Chemistry, Theoretical and Practical.* Vol. I. Physical and Inorganic Chemistry. Twelfth Edition, Revised and Corrected by HENRY WATTS, F.R.S. London: J. and A. Churchill.

THIS work has since its first appearance been greatly extended and much modified, in accordance with the progress of research and the changes in theory. Only three editions were prepared by the author. The six following, edited by Drs. Bence Jones and A. W. Hofmann, were enriched with much important matter. The tenth and eleventh, as well as the present, are edited by Dr. H. Watts, whose name will be a sufficient guarantee for accuracy, and for a judicious selection of matter and for its convenient arrangement. The growing bulk of the subject has rendered essential a division into two volumes, the first of which, now before us, embraces chemical physics, and inorganic chemistry, while organic chemistry is the subject of the second.

Among the more important editions may be mentioned fuller descriptions of the rarer elementary bodies, and a more complete account of the characteristic reactions of the metals. The author's plan of describing first the non-metallic elements and their respective combinations, before entering upon the discussion of the main features of chemical philosophy, has been retained, though a brief account of the atomic theory is introduced immediately after the description of the compounds of oxygen. To attempt any formal examination of, or to search for errors in, a work upon which the chemical public has long ago expressed its opinion, and which has passed through the hands of editors of such unquestionable competence, would be a mere waste of time. The present edition, as adapted to the requirements of the day, will be no less favourably received than were its predecessors.

*Year-Book of Pharmacy, comprising Abstracts of Papers relating to Pharmacy, Materia Medica, and Chemistry, from July 1st, 1875, to June 30th, 1876, with the Transactions of the British Pharmaceutical Conference at the Thirteenth Annual Meeting, held in Glasgow, September, 1876.* London: J. and A. Churchill.

THE nature of this work may be correctly learnt from its rather lengthy title. The first portion consists of facts and discoveries in pharmacy, materia medica, as well as in chemistry, pure or analytical. It must be, of course, admitted that most of the contents of a yearly record closed nearly ten months ago must be already familiar to the scientific world. It appears, however, that the subject matter has been very carefully and judiciously selected.

The latter part of the work is devoted to the transactions of the Pharmaceutical Conference. This Society is by no means confined to pharmacutists, but embraces many eminent chemists and others who have no professional connection with pharmacy, though interested in its progress.

There is an excellent general index, but an index of

authorities quoted would be in our opinion a valuable addition.

*The People v. Daniel Schrupff. Argument of W. P. Prentice, Counsel to the Board of Health, for the Prosecution.* New York: J. F. Trow and Son.

THIS pamphlet gives an account of a case of milk adulteration which seems to have excited considerable attention in the United States. The defendant, one Daniel Schrupff, was accused and ultimately convicted of the very common sin of milkmen—dilution with water, and seems to have become a kind of representative man, the champion of the "Milk-Dealers' Association." The line of defence adopted was one with which we are already tolerably familiar in this country. It was attempted to show that natural milk fluctuates so greatly in its composition that its character, genuine or sophisticated, cannot be ascertained either by chemical analysis, by determination of specific gravity, or by any other method whatsoever. This doctrine, dear to the heart of every dishonest dealer, was insinuated to some extent before the last Parliamentary Committee on Adulteration, and produced there, as was intended, evil fruits. On the occasion here recorded it was signally refuted; the low-standard milk was an abnormal fluid, containing pus globules, and had been obtained from cows far advanced in pregnancy. The results of this case will be a "heavy blow and great discouragement" to sophistication throughout America, and its influence will doubtless be felt here also.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Bulletin de la Societe Chimique de Paris,*  
No. 10, May 20, 1877.

**On an Easy Mode of Preparing Crystalline Phosphorous Acid.**—H. Grosheintz.—Trichloride of phosphorus, heated to  $60^\circ$ , is carried along by a current of dry air, the vapours being passed through two flasks, each containing about 100 grms. of water cooled to  $0^\circ$ . After the lapse of about four hours the contents of the first flask are saturated and converted into a thick crystalline paste. This is thrown upon a funnel plugged with asbestos, freed from the mother-liquor by means of the filter-pump, washed three times with very small quantities of water cooled to  $0^\circ$ , and dried in a vacuum.

**Preparation of Alkaline Nitrites.**—A. Etard.—The author reduces nitrates by means of the sulphite of potassium or sodium previously dried. Equal molecules of the two salts are melted in a crucible, and the mass, when cold, is pulverised and extracted with alcohol, which dissolves out the pure nitrite.

**On a General Reaction yielding Compounds analogous to Chrome-Iron.**—M. Gerber.—The author heats to redness, in a crucible, an anhydrous metallic chloride with potassic bichromate. The resulting mass is lixiviated with boiling water, and then treated with hydrochloric acid, in order to eliminate small quantities of metallic oxide which have not entered into combination. In this manner he has formed a considerable number of chromites.

**Determination of Tin by means of Standard Solutions of Ferric Chloride or Cupric Chloride.**—H. Pellet and A. Allart.—Reserved for insertion in full.

**On a Method of Producing Tartronic Acid.**—E. Grimaux.—The author having caused baryta to act upon bibromated pyruvic acid, obtained tartronic acid,  $\text{C}_3\text{H}_4\text{O}_5$ , with its characteristic properties.

On a New Red Colouring-Matter accompanying Chlorophyll.—C. Bougarel.—Reserved for insertion in full.

Absence of Rotatory Power attributed to the Iodide of Triethyl-methyl-stibine.—J. A. Le Bel.—Already noticed.

Preparation of Nicotin.—W. Kirchmann.—Tobacco, previously steeped in carbonate of soda, is introduced into a wrought-iron vessel fitted with two tubulures. One of these receives a tube passing to the bottom of the vessel, and serves to convey a current of carbonic acid gas into the apparatus. The other receives a delivery tube for the escape of the gas, and plunges into a mixture of alcohol and dilute sulphuric acid. The whole is heated in the water-bath, the current of carbonic acid allowed to enter, the sulphuric liquid is treated with baryta, evaporated to dryness, and the residue treated with ether, which dissolves the free nicotin. The acid solution of sulphate of nicotin, if treated with hydrate of alumina, yields fine octahedral crystals of nicotine-alum (*Archiv. der Pharmacie*, xxxiv., 16).

Xanthate of Potassa used for the Determination of Sulphide of Carbon, Salts of Copper, and Caustic Alkalies, even in Presence of Alkaline Carbonates and Sulphuretted Compounds.—E. A. Grete.—Reserved for insertion in full.

"Plastic Crystal" of Dinas.—C. Bischof.—The substance so named is a variety of Portland cement remarkable for its plasticity, and consisting of—

Silica .. .. .	86.42
Alumina .. .. .	9.33
Oxide of iron .. .. .	0.86
Lime .. .. .	0.34
Magnesia .. .. .	0.22
Alkalies .. .. .	0.37
Loss on ignition .. .. .	2.40

99.94

—*Dingler's Polyt. Journal*.

Manufacture of Soluble Glass from Infusorial Earth.—F. Capitaine.—The author recommends infusorial earth, very plentiful in North Germany, as suitable for yielding silicate of soda, by treatment with a caustic lye at sp. gr. 1.2, under a pressure of three atmospheres. The soluble glass thus obtained is much richer in silica than that made from flints.

*Moniteur Scientifique, Quesneville.*  
May, 1877.

Synthesis of Polybasic Acids by the Action of Carbonic Acid upon Salicylic Acid.—H. Ost.—The acids in question are the orthophenol-dicarbonic and phenol-tricarbonic.

Note on the Sewage of Paris.—C. Lauth.—The author finds that sewage saturated with air is not putrescible. By aëration the nitrogen of the insoluble portions decreases, whilst that of the soluble parts increases in the same proportion. There is no formation of nitrates, but the quantity of ammonia augments greatly. The hydrosulphuric putrefaction of sewage may be prevented by simple aëration.

Review of Physics.—R. Radan.—Under this title the author gives a series of compilations on the mutual relations of electricity and light; on a new method of determining the melting-points of various bodies (M. J. Löwe, in *Dingler's Journal*, cci.; Wolff, in *Archives de la Pharmacie*, iii.; and Prof. Himly, in *Poggendorff's Annalen*, 1877, No. 1); on a new syphon barometer (Bohn's, shown at the Loan Exhibition of Scientific Apparatus at South Kensington); on the absorption of rays of heat by watery vapour (M. Haga, in *Poggendorff's Annalen*, 1877); and on actinometric researches. In this last memoir the author gives an abstract of the investigations of MM. Bunsen, Roscoe, E. Marchard, Violle, and Crova.

Elements of Natural Vanillin.—MM. Tiemann and Haarmann.—An extract from the *Berichte der Deutschen Chemischen Gesellschaft*.

Extraction of Borax in California.—Taken from the *Bulletin de la Société d'Encouragement*, February, 1877.

Fixation of Indigo upon Tissues.—M. Prud'homme.—After giving a brief summary of the present methods of fixing indigo upon tissues, the author proceeds:—"We have recently discovered a new method of reducing and fixing indigo, which, without great practical value, presents nevertheless some interesting peculiarities. A mixture of glycerin, carbonate of soda, and protoxide of tin, in a paste, reduces indigo perfectly at about 120°. If water is used instead of glycerin the reduction is incomplete."

St. George's Hospital.—A short time since the death of Dr. Noad, F.R.S., was announced. Dr. Noad had held the Lectureship of Chemistry and Physics at the Medical School of St. George's Hospital for the space of thirty years. Among his contributions to science some of our readers will recollect his researches (now many years ago) "On Certain Compounds belonging to the Aromatic Series." He was also well known as an authority as to the value of iron ores. He was the author of "A Manual of Chemical Analysis," and of a work on "Electricity." His loss will be felt in many quarters. Professor Wanklyn has just been appointed Lecturer on Chemistry and Physics in the room of Dr. Noad.

## CHEMICAL LABORATORY, WIESBADEN, GERMANY.

Director—Prof. R. FRESENIUS, Ph.D.

### LECTURES.

Experimental Chemistry (Inorganic), Prof. R. FRESENIUS, Ph.D.; Experimental Physics, Organic Chemistry, and Theoretical Chemistry, Prof. C. NEUBAUER, Ph.D.; Chemical Technology, H. FRESENIUS, Ph.D.; Botany and Zoology, Prof. L. KIRSCHBAUM, Ph.D.; Mineralogy, C. KOCH, Ph.D., State Geologist; Practical Instruction in the Laboratory, Prof. R. FRESENIUS, Ph.D., H. FRESENIUS, Ph.D., and two Assistants.

The next Session commences on the 15th of October. The Regulations of the Laboratory and the Syllabus of Lectures will be forwarded gratis on application to C. W. KREIDEL'S Verlag, at Wiesbaden, or to the undersigned.

Prof. R. FRESENIUS, Ph.D.

## COLLEGE OF CHEMISTRY, DUKE STREET, LIVERPOOL.

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# THE CHEMICAL NEWS.

VOL. XXXVI. No. 927.

## ON REPULSION RESULTING FROM RADIATION.—PART IV.\*

By WILLIAM CROOKES, F.R.S., &c.

(Concluded from p. 56.)

### The Measurement of Force.

209. I have long endeavoured to devise some means of measuring the amount of force exerted by radiation, from a standard candle for instance at a foot off, on a measured surface of matter. The data given in pars. 199 and 200 are sufficient to enable the amount of force acting on the pith disks to be calculated indirectly; but I wished to have a means of measuring the force by as direct a method as we have of getting the weight of a ponderable body. I wanted an apparatus which will give me, at once, the pressure in grains which a ray of light exerts on a surface

filament of silk ( $mo$ ); this silk is attached to one end of a steel spring ( $p$ ), which is held firmly at the other end by the solid rod ( $q$ ) cemented to the glass tube ( $de$ ). The torsion-fibre ( $mn$ ) passes over the knife-edges ( $ll$ ), which thus support the beam. The tension of the spring ( $p$ ) is so adjusted that the glass fibre shall remain stretched under a constant pull of about 100 grains.  $tt$  is a circular card cemented to the end of the tube ( $g$ ) and divided into 360 degrees. On the stopper ( $r$ ) is fixed a pointer ( $u$ ), which revolves with it, and marks the degrees through which it has turned. The complete revolutions are recorded on a "counter" ( $w$ ). Motion is given to  $r$  by a torsion-handle ( $v$ ). The apparatus is connected to the pump by the spiral ( $x$ ), which works in a stopper tap ( $y$ ) most ingeniously devised by my friend and assistant Mr. C. H. Gimingham, so as to enable the instrument to be disconnected from the pump and attached to it again without interfering with the exhaustion.\*

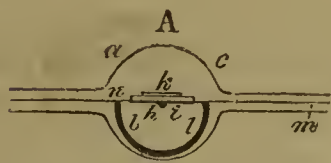
The stopper ( $r$ ) is very accurately ground and polished in the tube at  $s$ , as long a surface as possible being in contact. It should be lubricated by setting fire to a piece of plain india-rubber, and allowing the melted drops to fall on the contact surfaces. This is a nearly perfect lubricant, allowing very free movement and preventing any access of air.

210. The torsion-fibre must be selected with great care.

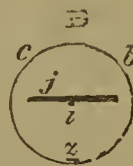
FIG. 17.



Plan.



Vertical section of cross tube at the centre.



Vertical section of cross tube at the end containing the pith.

Elevations and details.

on which it may fall. Such an apparatus is shown in fig. 17.

The principle of the construction is that of the torsion-balance first described by W. Ritchie, F.R.S., in 1830.†  $ab$  is a glass tube 13.5 inches long, 1 inch wide as far as  $ac$ , and 1.2 inch wide at  $cb$ . It is closed at the end  $a$ , and ground flat and polished at the end  $b$ , so as to be capable of being closed by a plate of glass cemented on.  $de$  and  $fg$  are two narrower tubes sealed into  $ab$ , as shown, the part  $de$  being 17 inches long, and  $fg$  38 inches long.  $de$  is  $\frac{1}{2}$  an inch in diameter, and is closed at the end;  $fg$  is  $\frac{1}{4}$  of an inch diameter.  $hi$  is a thin glass beam, having a glass weight at the end  $h$ , and a flat surface of lampblack pith ( $j$ ) at the end  $i$ . The pith ( $j$ ) exposes exactly 2 square inches of surface. It is prevented from curling up in the vacuum by cutting it partly through at intervals, as shown.  $k$  is a silvered mirror, cemented on to the centre of the glass beam;  $ll$  are two knife-edges of glass, finely ground and polished;  $mn$  is a very fine fibre of glass cemented to the beam ( $hi$ ) beneath the mirror ( $k$ ). The end ( $n$ ) of the glass torsion-fibre is attached to the solid stopper ( $r$ ), which is carefully ground and polished into the contracted part of the tube ( $s$ ). The other end of the torsion-fibre ( $m$ ) is cemented to a

Ten threads were drawn (103) and were suspended from a horizontal beam. Weights were then gradually hung on to the lower ends. Only two were found strong enough, the others having broken before 450 grains had been added. The one selected stood 450 grains without breaking. Its diameter is less than 0.001 inch.

The torsion of the glass fibre was taken by the method given in par. 186. With the weight of 15.46 grains hanging on to it half an oscillation took 30 seconds.

A fellow thread, selected of as nearly as possible the same strength and tension, and having a weight of about 100 grains at the end, broke when it was twisted 36 times. The actual thread used in the balance has been tested up to 30 turns without breaking.

211. A flat oblong piece of soft iron, weighing accurately 0.01 grain, is put loose into the cross tube under the pith surface (see  $z$ , fig. 17, vertical section of cross tube). This weight can be picked up by a horseshoe magnet outside the tube, and dropped on any part of the pith. A mark is made at the exact centre of the pith surface, and by moving the magnet about, it is easy to place the iron weight accurately on this mark.

212. A silvered glass mirror is supported at an angle of  $45^\circ$  over the pith surface, and so that the centre of the mirror is 2 inches from the pith when the beam is in

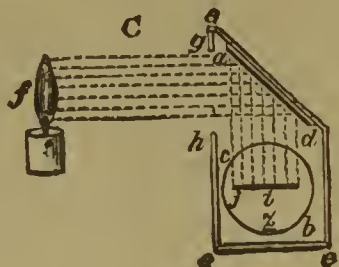
\* A Paper communicated to the Royal Society, February 5, 1876. From the *Philosophical Transactions of the Royal Society of London*, vol. clxvi., part 2.

† *Phil. Trans.*, vol. 120 (for 1830), p. 215.

\* I have asked Mr. Gimingham to send a description of this tap and some useful improvements he has introduced in the mercury-pump, to the Royal Society.

equilibrium. The whole is enclosed in a blackened box, in such a manner that when a candle is placed a few inches from the mirror in a horizontal line with its centre, no direct ray, but only the reflected ray falls on the pith. Fig. 18 shows the arrangement:  $ad$  is the mirror;  $eeee$  is the wooden frame with the aperture ( $gh$ ) in front to allow the flame of the candle ( $f$ ) to fall on the mirror and thence be reflected on to the pith without illuminating the pith with direct rays.  $bc$  is the cross tube,  $j$  the pith, the beam, and  $z$  the iron weight.

FIG. 18.



213. A ray of light from a lamp is directed on the small central mirror ( $k$ , fig. 17) of the beam, whence it is reflected back to a millimetre scale 4 feet off, forming a sharply defined image, and making evident by its movement the slightest angular motion of the beam. When the reflected ray points to zero on the scale, it is evident that a turn of the torsion-handle ( $v$ ) in one or the other direction will raise or depress the pith end of the beam, and thus cause the index ray to travel along the scale to the right or to the left. It is also evident that if a small weight is placed on one end of the beam so as to depress it, and the torsion-handle be then turned, the tendency of the glass fibre to untwist itself will ultimately balance the downward pressure of the weight, and (provided the glass torsion-fibre does not break) will bring the beam to a horizontal position, the index ray again pointing to zero. The object of the spring  $p$  is to keep the torsion-thread always stretched; and the silk fibre ( $mo$ ) connecting the torsion-fibre and the spring is to allow the whole of the torsion of the fibre to be utilised in moving the beam, as the filament of silk may be considered practically free from torsion.

214. The first operation was to ascertain the number of degrees of torsion which were equal to the  $\frac{1}{100}$  of a grain weight. The apparatus being well exhausted,\* the index ray of light being at zero, and the pointer of the torsion-handle standing at  $0^\circ$  on the divided circle, the iron weight was picked up by a magnet, and placed exactly on the centre of the pith surface. The end of the beam instantly fell down, and I had to turn the torsion-handle 27 complete revolutions and  $353^\circ$  in addition, or  $10073^\circ$ , before the beam became horizontal and the index ray again stood at zero.† The downward pressure of  $\frac{1}{100}$  of a grain was therefore equivalent to the force of torsion of the glass thread when twisted through  $10073^\circ$ .

215. My next operation was to find out the degree of delicacy of the balance. The law of torsion is that the force with which the glass fibre tends to untwist itself is directly proportional to the number of degrees through which it has been twisted.‡ I can therefore find out the smallest amount of weight which the balance will indicate by ascertaining what is the smallest angular movement of the torsion-handle which will cause an appreciable movement of the index ray of light.

I found that a movement of three degrees of torsion sent the index ray a considerable distance. One degree of torsion gave a very decided movement, whilst half a degree displaced the index ray to a sufficient extent to be easily seen. I believe less than half a degree could have been detected had the scale been further off; but not to

run any risk of over-estimating the delicacy of the balance, I will take one degree of torsion as its ordinary working limit.

To what fraction of a grain will this torsion of one degree be equivalent? This is easily calculated. A twist through  $10,073^\circ$  balances the  $\frac{1}{100}$  of a grain; a twist of  $10,074^\circ$  overbalances it.

$$\begin{aligned} 10,073^\circ &: 0.01 \text{ grain} :: 10,074^\circ : 0.01000099 \text{ grain} \\ \therefore 10,074^\circ - 10,073^\circ &= 0.01000099 \text{ grain} - 0.01 \text{ grain}, \\ \therefore 1^\circ &= 0.0000099 \text{ grain}. \end{aligned}$$

The balance will therefore turn to the  $\frac{1}{100000000}$  of a grain.

Divide a grain weight into a million parts, place one of them on the pan of my balance, and the beam is instantly depressed!

216. The balance was exhausted up to the highest point, the index ray of light was projected on to the scale, and the apparatus was kept in darkness, well protected from external influences by screens around it. The index ray soon became stationary; it was then brought to zero, and the pointer of the divided circle set to  $0^\circ$ , the counter also being at 0.

A standard candle was then adjusted 10 inches from the centre of the mirror, and therefore 12 inches from the surface of the pith. The screens were removed, and the reflected rays of the candle were allowed to fall perpendicularly on to the pith surface. The pith instantly sank to the bottom of the tube, and the torsion-handle had to be turned through  $442^\circ$  to restore equilibrium.

The  $\frac{1}{100}$  of a grain required  $10,073^\circ$  of torsion to restore equilibrium (214); and the ratio between the weights being the same as that between the degrees of torsion, the mechanical force of the radiation from the candle is easily calculated:—

$$10,073^\circ : 0.01 \text{ grain} :: 442^\circ : 0.0004387 \text{ grain}.$$

Other experiments were tried, the candle being blown out and the apparatus allowed to cool in the dark between each. The following Table gives the results:—

Mechanical Force of Radiation from a candle on  
2 square inches of blackened pith.

Distance of candle from pith.	Degrees of Torsion.	Mechanical Pressure. Grain.	Difference of last column from mean. Grain.
12 inches .. ..	442°	0.000438	—0.000006
„ „ .. ..	449	0.000445	+0.000001
„ „ .. ..	452	0.000448	+0.000004
Mean .. ..	448	0.000444	
6 inches .. ..	1815	0.001801	+0.000029
„ „ .. ..	1800	0.001787	+0.000015
„ „ .. ..	1740	0.001727	—0.000045
Mean .. ..	1785	0.001772	
6 ins., with water-cell interposed	235	0.000233	

The pressure at 12 inches off is 0.000444 grain, whilst that at 6 inches is 0.001772 grain. At half the distance the pressure should be four times, or 0.001776 grain. The difference between theory and experiment, being only 4 millionths of a grain, is a sufficient proof that the indications of this instrument, like those of the previously described apparatus, follow the law of inverse squares.

The last column in this Table, the “difference from mean,” shows that my estimate of the sensitiveness of this balance is not excessive, and that in practice it will safely indicate the millionth of a grain.

217. I have tried in vain to get a good observation with sunlight. On the very rare occasions within the last few months on which the sun has been shining brightly my balance has not been in adjustment, or I have been away from home. I was able, however, on December 13th last to get a few observations. The sun was obscured by

\* This preliminary testing the value of the 1-100 grain weight can be equally well performed in air.

† This is the mean of several concordant experiments.

‡ Biot, *Traité de Physique*, tome i., p. 486. Ritchie, *Phil. Trans.*, vol. cxx., p. 215.

thin clouds and haze, and its rays were but faint. The pressure of its radiation was, on this occasion, only equal to that of 10.2 candles, six inches off, pressing down the pith, therefore, with a weight of 0.018074 grain.

218. But the result of my observations of the sun on Dec. 13th being only equal to 10.2 candles 6 inches off, is of course far below the real power of the unclouded mid-summer sun. I propose trying this experiment under more favourable circumstances. Meanwhile I have endeavoured to find what results in this direction have been obtained by other observers. The data given by different authorities vary considerably, as will be seen by the following Table:—

Baugee*	found that sun =	62,280 candles 1 metre off.
Wollaston†	„ „ =	59,830 „ „ „
Becquerel‡	„ „ =	50,000 „ „ „
Zöllner§	„ „ =	154,500 „ „ „

In these cases the sun was measured when at the highest point in a clear sky, and the *optical* difference alone was taken. In my case the light was very faint and hazy, and the total radiation, both of the sun and of the candle, was measured. I do not give my results as attaching the least importance to the actual figures, but simply as an illustration of the marvellous sensitiveness of the instrumental means at my disposal. I hope during the forthcoming summer to work out the subject more fully, and to be in a position to communicate to the Society many observations obtained with the torsion-balance, not only in photometry and the repulsion caused by radiation, but in other branches of science in which the possession of a balance of such incredible delicacy is likely to give valuable results.

POSTSCRIPT.—January 17, 1877.

In the foregoing paper, pars. 126, 128, 155, 156, 157, 158, 159, 170, and 171, experiments are referred to which show that the repelling force appears to be different on a white or a black surface according as the radiation causing the movement is dark heat (from the fingers, hot water, hot glass, or copper below 250° C.) or the luminous rays. In commenting on these results, I gave what appeared at the time to be the most reasonable explanation. Twelve months' research, however, has thrown much light upon these actions; and the explanation afforded by the dynamical theory of gases makes what was a year ago obscure and contradictory, now reasonable and intelligible.

In a preliminary notice submitted to the Royal Society, Nov. 16, 1876, and published in No. 175 of the *Proceedings*, I gave the explanation of the movements of repulsion under the influence of radiation according to the dynamical theory of gases, first, I believe, used in this connexion by Mr. Johnstone Stoney. In this preliminary notice I brought forward experimental proof that the presence of residual gas is the cause of the movement of the radiometer, and generally of the repulsion resulting from radiation, the maximum effect being at a pressure of about 50 millionths of an atmosphere. According to the dynamical theory of gases, the repulsion is due to the internal movements of the molecules of the residual gas. When the mean length of path between successive collisions of the molecules is small compared with the dimensions of the vessel, the molecules rebounding from the heated surface, and therefore moving with an extra velocity, help to keep back the more slowly moving molecules which are advancing towards the heated surface; it thus happens that though the individual kicks against the heated surface are increased in strength in consequence of the heating, yet the number of molecules struck is diminished in the same proportion, so that there is equilibrium on the two sides of the disk, even though the temperatures of the faces are unequal. But when

the exhaustion is carried to so high a point that the molecules are sufficiently few and the mean length of path between their successive collisions is comparable with the dimensions of the vessel, the swift moving, rebounding molecules spend their force, in part or whole, on the sides of the vessel, and the onward crowding, more slowly moving molecules are not kept back as before, so that the number which strike the warmer face approaches to, and in the limit equals, the number which strike the back, cooler face; and as the individual impacts are stronger on the warmer than on the cooler face, pressure is produced, causing the warmer face to retreat.

This theory explains very clearly how it was that I obtained such strong actions in my earlier experiments when using white pith as the material to be repelled, and employing the finger as a source of heat, and how it happened that I did not discover for some time that dark heat and the luminous rays were essentially different in their actions on black and white surfaces. The explanation of this is as follows:—Rays of high intensity (light) pass through the wall of the glass vessel without warming it; they then, falling on the white surface, are simply reflected off again; but falling on the black surface they are absorbed, and, raising its temperature, produce the molecular disturbance which causes motion. Rays of low intensity (dark heat) do not, however, pass through the glass to any great extent, but are absorbed and raise its temperature. This warmed spot of glass now becomes the repelling body, through the intervention of the molecules rebounding from it with a greater velocity than that at which they struck it. The molecular pressure, therefore, in this case streams from the inner surface of the warm spot of glass on which the heat-rays have fallen, and repels whatever happens to be in front of it, quite irrespective of the colour of its surface.

#### ON THE COMPOSITION OF LIEVRITE, AS DETERMINED BY MR. EARLY'S METHOD.\*

By J. EMERSON REYNOLDS, M.D., M.R.I.A.,  
Professor of Chemistry, University of Dublin.

OF the several methods which have been devised for the analysis of ferroso-ferric silicates that which has been published by Mr. William Early,† Demonstrator of Chemistry in this Laboratory, is probably the most easily managed. The advantages attending its use are chiefly felt in analysing silicates, which are either insoluble in or attacked with difficulty by the ordinary acids; but it can also be used with great convenience in the analysis of silicates easily acted upon by acids. Lievrite is a silicate belonging to the latter class; and as the formula of the mineral is by no means definitely fixed, I requested Mr. Early to analyse by his method a portion of a particularly fine crystal which I obtained some time ago from the well-known Elba locality, our chief aim being to determine with precision the relative amounts of ferrous and ferric compounds present in the specimen.

The analysis was conducted in the following manner:—1.54 grms. of the finely and recently powdered mineral were mixed with 20 c.c. of hydrofluoric acid (containing 20 per cent of real acid), and the mixture was boiled for five minutes in a deep platinum crucible with a rather loosely-fitting cover: 10 c.c. of diluted sulphuric acid (1 part to 2 parts of water) were then added, and the boiling continued for a few minutes. The contents of the crucible were then washed into a flask with air-free water, and the amount of iron in the ferrous condition determined as rapidly as possible by standard potassic permanganate solution. Another quantity of the mineral was acted upon by strong hydrochloric acid; perfect decompo-

\* "Essai d'optique sur la gradation de la lumière, 1729, p. 30.

† *Phil. Trans.*, vol. 89, 1799.

‡ *Ann. de Chim. et de Phys.*, 3 série, t. lxii., p. 34, 1861.

§ Private letter to the author.

\* Read before the Royal Irish Academy.

† *CHEMICAL NEWS*, vol. xxxi., p. 169.

sition was effected, and a gelatinous mass formed; the product was evaporated to dryness, and the silica separated in the usual way. The acid filtrate from the insoluble silica was then saturated with chlorine gas, and ammonia afterwards added in slight excess; the mixture produced was then boiled in a closely-covered beaker in order to remove the excess of ammonia, the solution rapidly filtered, and the precipitate collected and ignited with the usual precautions, and weighed. The product contained all the iron as ferric oxide, the alumina, the manganese as  $Mn_3O_4$ , and a trace of silica. The silica was separated from this mixture by hydrochloric acid, and the filtrate was subjected to the double treatment with pure caustic soda for the separation of alumina. The iron and manganese were then separated by the baric-carbonate method. From the weight of iron thus found that previously ascertained to be present in the ferrous state was deducted; the difference represented the weight of metal in the ferric condition. The filtrate from the first precipitate caused by ammonia had the calcium separated from it as oxalate, and the latter was determined in the usual way; the filtrate from the calcium precipitate was then evaporated to dryness, and the residue heated to expel ammoniacal salts: the product of this treatment was dissolved with the aid of a few drops of hydrochloric acid, the magnesium separated by means of baric hydrate and estimated, while the alkalies in the filtrate were converted into chlorides and weighed, and the potassium separated by platinic chloride. No trace of lithium was detected in the mineral.

2.841 grms. of the freshly-powdered and unaltered mineral were heated gradually to redness in a hard glass tube connected with a weighed chloride-of-calcium tube; a current of dry air was at the same time slowly drawn through the apparatus. The water collected weighed 0.012 grm. = 0.422 per cent only.

The percentage composition of the specimen analysed by Mr. Early may be thus stated, when the metallic and other components are calculated as oxides:—

SiO <sub>2</sub>	..	..	..	..	..	29.93
FeO	..	..	..	..	..	31.83
Fe <sub>2</sub> O <sub>3</sub>	..	..	..	..	..	20.16
MnO	..	..	..	..	..	3.02
CaO	..	..	..	..	..	13.71
MgO	..	..	..	..	..	0.30
Al <sub>2</sub> O <sub>3</sub>	..	..	..	..	..	0.36
K <sub>2</sub> O	..	..	..	..	..	0.20
Na <sub>2</sub> O	..	..	..	..	..	0.29
H <sub>2</sub> O	..	..	..	..	..	0.42
						100.22

These data, when discussed in the usual way, give the following ratios:—

SiO <sub>2</sub>	..	..	..	=0.4983=3.85=4.00
RO	..	..	..	=0.7431=5.74=5.96
R <sub>2</sub> O <sub>3</sub>	..	..	..	=0.1294=1.00=1.04

or—



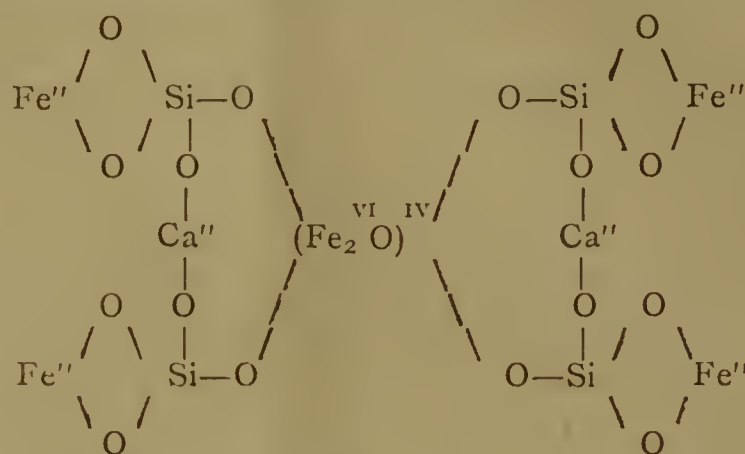
where  $6RO=4(Fe,Mn)O+2CaO$  nearly, neglecting the small amount of alkalies.

As the water present in the particularly pure specimen of the mineral analysed did not reach 0.5 per cent, it is difficult to admit, with Städel, that it enters into the molecule of the compound; I therefore prefer to regard Lievrite as an anhydrous silicate.

Mr. Early's analysis of the mineral agrees in all essential particulars with those of Rammelsberg and Von Kobell, though both those distinguished observers found slightly more iron in the ferric condition. A comparison of the analyses of different specimens of Lievrite by Rammelsberg, Von Kobell, Städel,\* and Early, prove that there is little variation in the proportion of Fe<sup>VI</sup>

to Fe<sup>IV</sup>: I am therefore disposed to regard the former as an essential constituent of the mineral, rather than as a product of the oxidation of a calcio-ferrous silicate. That the mineral oxidises in time there can be no doubt; but I have had a number of specimens of Lievrite under observation for nearly ten years, and though two of them were placed in a rather damp case they suffered comparatively slight superficial oxidation.

If, then, we admit that Lievrite is essentially a dicalcic ferroso-ferric silicate, we can assign to it the following symmetrical formula:—



This formula has at least the merit of indicating that the function of the ferric group is probably one of considerable importance, and that, so far from being regarded as an accidental constituent of the mineral, it ought to be considered one of the most important components of the molecule of the compound.

#### NOTE ON THE DOUBLE DECOMPOSITION OF POTASSIC BROMIDE AND SODIC CHLORIDE.

By J. H. BILL, Surgeon U.S. Army.

In the practice of analytical chemistry it is the custom, in arranging and recording the results, to associate the "strongest acid" with the "strongest base." Thus, if barium, potassium, sulphuric and nitric anhydrides are found in a compound, in the statement of the analysis we associate together the barium and sulphuric anhydride and the potassium and nitric anhydride.

In this record nothing is assumed, for the basic sulphate separates as an insoluble powder, the potassic nitrate remaining in solution a soluble crystalloid.

Again, if potassium, sodium, chlorine, and bromine are found in a mixture, we record the results as so much potassic chloride and sodic bromide; or if we mix solutions of potassic bromide and sodic chloride, we hold that potassic chloride and sodic bromide exist in the mixture in consequence of a double decomposition. On what do we rest such an assumption? Is it on anything more than analogy? The haloid salts of potassium and of sodium have nearly the same solubility and crystalline forms. We get no precipitate on mixing their solutions, nor characteristic crystals on evaporating these, nor change of colour in the solutions themselves, nor other evidence that the chemical relations of the several bodies have been altered. In short, our belief in this alteration is purely hypothetical.

Several years ago, while conducting a physiological research on the action of the bromides, I observed certain facts which I here offer as a demonstration of the proposition that potassic bromide and sodic chloride, when brought together in solution, undergo double decomposition.

If 5 or 6 grms. of potassic bromide are administered to a healthy man, his urine of the succeeding twenty-four hours will show the following changes:—Nearly all the potassium ingested as potassic bromide will be found in the urine in addition to that naturally present, united with

\* See Dana's "System of Mineralogy," 5th edition, p. 296.

chlorine augmented according to the amount of bromide taken; the sodium scarcely altered in quantity; the sulphates and phosphates unchanged; only a very little bromine will be found. Bromides, however, may be detected for two weeks after the last dose taken, whilst excess of potassium will be found only after the first day.

I can account for these facts only on the supposition that the potassic bromide ingested was decomposed by the sodic chloride of the blood, potassic chloride—excreted by the urine—and sodic bromide—retained in the blood as a substitute for sodic chloride—resulting.

Further, this decomposition was the result of simple chemical affinity. We know of no instance where a "vital force" changes in the body the usual action of chemical force, and we have no right to assume it here. We hold the reaction, therefore, to be a universal one. I submit the average result of three analyses when no bromide was taken, and the average results of six analyses of urine when the body was under the influence of from 5 to 10 grms. of potassic bromide. The results show the amounts of the whole twenty-four hours, all the urine for that period being collected. The method was to incinerate a portion of the urine, and from the ash to separate the alkaline earths, sulphates, and phosphates. The sodium and potassium were then estimated in the form of chlorides by the indirect method. The chlorine and bromine were also estimated indirectly.

	Potassium. Grms.	Sodium. Grms.	Chlorine. Grms.	Bromide Grms.
No bromide taken	4.21	7.67	9.56	—
Seven grains (average) of bromide taken	6.52	7.82	11.45	0.04

I have waited for a chance to extend these experiments to the reaction of the iodides and chlorides, but seeing no probability that an immediate opportunity of doing so will present itself, I publish this note for what it is worth.—  
*American Journal of Science and Arts.*

## ON CRYSTALLISED GRAPE-SUGAR.

By W. E. HALSE and J. STEINER.

IN 1875 a cargo of starch-sugar was sent from England to Australia, but not having been accepted there it had to be brought back. On being offered here for sale it was found to be partially crystallised and to resemble cane-sugar, and it actually was taken for such. For this reason samples were sent to us for analysis, and in the following we give an account of this singular case:—

The received samples were of three different sorts—amorphous, amorphous with crystallisation on it, and others completely crystallised.

The amorphous substance, not differing in anything from common starch-sugar, is greyish white, and with stripes of brown passing through it. It feels dry, pulverulent, is hard, and slightly hygroscopic.

The second sample consisted of amorphous dark brown lumps, of a very pasty nature, with completely developed crystalline groups (rosettes) imbedded in it, and a yellow, very fine-crystallised, thin crust on some parts of the surface.

The rosettes are from the size of a bean up to that of a chesnut, and have a clear amber or pale yellow colour, with a fatty glance. The leaves in these rosettes resemble, in the outer part, front teeth, or wedges with spheric surface and sharp edges. By means of a knife these latter may be separated from the group without being broken. They seem a little harder than cane-sugar crystals, and are very brittle.

To free the rosettes from the adhering amorphous substance they were first immersed in dilute alcohol, then dipped in absolute alcohol, and subsequently dried with

filter-paper. In this way we separated twelve to fifteen rosettes, weighing each from 4 to 5 grms.

The third kind of sample presented completely crystallised compact pieces, which were composed of either wart-like crystals or only of a very fine and dense crystallisation. They kept dry in the open air, were very hard, so as to require hammer and chisel to break them up, and on being ground a dry powder resulted (which is never the case with ordinary starch-sugar). By repeatedly and carefully dipping such lumps in dilute alcohol a part of the mass was dissolved out, and a network of the larger wart-like crystals of an amber-yellow colour was obtained, having the structure of a sponge and coral-like cavities. The pieces with the very fine crystallisation are of a much darker colour than the others, and could not be treated in a similar way without being completely dissolved.

We now give the results of the analyses of the crystals (rosettes and warts), and also of the original samples:—

### CRYSTALS.

	Rosettes.	Warts of the size of a Bean.	Warts smaller.	C <sub>6</sub> H <sub>12</sub> O <sub>6</sub> +H <sub>2</sub> O, corresponding to—
Ash..	trace	trace	trace	—
Water ..	9.45	9.26	9.45	9.09
Glucose ..	90.35	90.45	90.20	90.91
Dextrin ..	0.20	0.29	0.35	—
	100.00	100.00	100.00	100.00

### SAMPLES.

	Amorph. with Rosettes.	Amorph. without Rosettes.	Fine crystal- lised.	Wart- like, small.	Wart- like, larger.	Amor- phous.
Ash ..	0.36	0.37	0.33	0.29	0.15	0.45
Water ..	12.00	12.20	11.80	11.20	10.50	8.60
Glucose ..	80.10	78.60	81.40	84.60	85.00	83.90
Dextrin ..	1.74	1.90	1.53	0.79	0.68	1.54
Optic inact. subst. ..	5.80	6.93	4.94	3.12	3.67	5.51
	100.00	100.00	100.00	100.00	100.00	100.00

The amount of substance insoluble in water in these samples is only trifling.

The ash consists chiefly of gypsum.

The drying, which required much care and attention, could only be effected at about 90° C. A higher temperature causes the crystals to caramelize and decompose.

The melting-point of the rosettes is near 85° C., and that of the warts about 90° C.

For the determination of the optic active substances (glucose and dextrin) the polariscope, in conjunction with Fehling's solution, was used, which is the only reliable method.

Precipitation of dextrin by alcohol can only be of use as a qualitative test, and even then the gypsum and some of the intermediate products present may influence the test when only small quantities of dextrin occur.

In considering the results of the analyses of the samples with the wart-like crystals we observe that only an increase of sugar takes place with the growth of the crystallisation, and not of the other parts (water, dextrin, and intermediate products), which therefore in proportion seem to decrease. We may also assume that, if it were practicable to separate completely the adherent amorphous mass from the crystals, they would be found to represent pure grape-sugar.

That crystals in two distinct forms, and both equally pure, should have been formed, and as it seems under similar conditions, is very interesting.

The amount of free acid in these samples was also determined; it ranges between 0.06 and 0.01 per cent SO<sub>3</sub>.

The darkening of the amorphous substance may have been effected by the combined action on partly caramelised products of moisture, lime, and of the ammonia liberated by the putrefaction of the albuminous matter (gluten) present. Caramel absorbs moisture more rapidly than

common starch-sugar. A long voyage in a tropical climate furnished not only the necessary conditions for the melting of the substance and for the development of ammonia, but was also favourable for such a slow crystallisation as grape-sugar requires. Once the crystallisation introduced, a continual growth took place.

Laboratory, 21, Mincing Lane.

## LABORATORY NOTES.\*

By J. T. DUNN.

### *On the Retarding Action of Glycerin.*

As suggested by Mr. Proctor at the last meeting, the action of a glycerin solution of iodine on iron was tried. Four cylinders were taken, and into each was put 25 c.c. of a solution of iodine in potassium iodine. They were then made up to 50 c.c., two with water and two with glycerin. A piece of iron wire was then placed in each; in two the wire was suspended near the surface of the fluid, and in the others it was placed at the bottom.

After a week it was found that the water solutions had been acted on much more rapidly than the glycerin solutions, the difference being most marked in the case of those in which the wire was at the surface.

In all the cylinders, however, the wire became covered with bubbles of gas, so that the protective action of the film of gas is not eliminated by using iodine. These bubbles were always larger and fewer in the water solutions than in the glycerin solutions.

A few days ago a corresponding set of cylinders were put up with bromine in place of iodine. Here the iron was rapidly attacked in the water cylinders, but the action in the glycerin cylinders appears to be complicated by other reactions, for the bromine in one is completely decolorised save at the bottom, and in the other the colour is paler than it was originally.

In this case, also, bubbles of gas were observed on the wires, larger and fewer in the water solutions than in the glycerin solutions.

### *On the Action of Ammonia on Sodium Phosphate.*

When strong ammonia is added to a cold saturated solution of sodium phosphate, a white, crystalline, slowly-subsiding precipitate falls, the amount of which varies with the proportions of ammonia and phosphate used. It begins to be formed when the proportion of ammonia to phosphate is about 1 to 2, and the maximum amount is produced with about 3 volumes of ammonia to 2 of phosphate solution. The precipitate is readily soluble in water, but practically insoluble in strong ammonia.

Analyses made on the small quantities I have hitherto obtained rather tend to show that its composition is not constant; but I hope shortly to prepare and submit to analysis a larger sample.

## NOTICES OF BOOKS.

*Agenda du Chimiste*, 1877, à l'usage des Ingénieurs, Physiciens, Chimistes, Fabricants de Produits Chimiques, &c.  
Paris and London: Hachette and Co.

THIS is an excellent little book, crammed with exact and valuable information for the chemist, physicist, and manufacturer. Like all French books of the kind, it is a model of what such books should be in the way of systematic arrangement. It is divided into three parts, the first consisting of physical and mathematical tables and

data; the second relates to pure chemistry only; while the third is devoted to chemistry applied to manufactures. The first part is preceded by an almanack, which ought to give the days of meeting of the principal scientific societies of Paris, but oddly enough gives only those of the French Chemical Society. The body of the work naturally begins with tables of weights and measures, and their foreign equivalents. Here there is another omission, which can only be looked on as accidental, but which should be remedied in the next edition. We allude to the omission of English apothecaries' weight, although those of Austria, Germany, Russia, and several other countries are given. Following weights and measures we have copious thermometrical, dilatation, barometrical, and vapour tension tables. Next to these we have nearly a hundred specific gravity tables, some eighty of which give the exact amount of gases, salts, acids, and other soluble bodies contained in solutions of a given density. These tables cannot fail to be of great use to English chemists and manufacturers, who are so frequently puzzled to find the strength of solutions in French formulæ where the specific gravity only is mentioned. Receipts for freezing mixtures, boiling- and fusing-points, the indices of refraction, and rotatory powers of different substances bring us to Part II. It commences, of course, with atomic weights and volumes, followed by a very complete and succinct series of analytical tables, a special feature being a list of the spectra of the different elements, with the wave-length of each line. A series of factors for analytical calculations, with their logarithms, is next given, and the part ends with copious data with respect to volumetric analysis generally, acidimetry, and alkalimetry. The third part treats entirely of manufacturing chemistry, and is as full of valuable information as its predecessors. It opens with Clark's soap-test, and gold and silver assaying, and gives a number of methods for the commercial analysis of raw chemicals and other products (such as soda-cake, pearlash, manganese, chrome-ore, clays, soap, wax, &c.). The list of alloys, amalgams, and solders is very full, but electric amalgam has apparently gone to look for English apothecaries' weight, for it is nowhere to be found. A very useful table for the conversion of French chlorimetrical degrees into English, and *vice versa*, is also given. Urinometry follows in company with photography, and tables showing the general properties of animal, vegetable, and mineral colouring-matters; the whole concluding with a number of laboratory receipts for such things as lutes, indelible inks, and special reagents.

So far we have nothing but the highest praise to bestow on this little book; but we must now point out a very grave defect, which notably detracts from its value as a book of handy reference—it has no index. When a work of this kind is referred to it is generally in a hurry, and nothing is more galling than to have to hunt out a fact from a mass of other matter when a proper index would enable the student to hit upon it at once. It may be said that a work so systematically arranged as the present has no need of an index, but a single instance will suffice to show the fallacy of such an idea. While the book was waiting for review, the writer had occasion to refer to it to find out the amount of sodium hyposulphite contained in a solution of the strength of 20° Baumé, but had to look through nearly eighty tables before it could be found. Charles Lamb said that a good book without an index was like a chronometer without a dial—an acute remark, which applies most forcibly to the excellent little work before us. *Apropos* of this subject, it is somewhat strange that the French—who are so systematic in other ways—should ignore the use of indexes in so many instances. The two excellent treatises on *Physics* by Privat Deschanel and Ganot are rendered almost useless as works of reference by the want of an index, although as manuals for consecutive study they leave nothing to be desired. On the other hand, an index to a Dictionary would seem to some persons to be a work of supererogation, but

\* Read before the Newcastle-upon-Tyne Chemical Society, March 22, 1877.

everyone knows the comfort and convenience of the indexes to Watts's *magnum opus*.

*Inorganic Chemistry, adapted for Students in the Elementary Classes of the Science and Art Department.* By Dr. W. B. KEMSHEAD, F.R.A.S., &c. London and Glasgow: W. Collins, Sons, and Co. 1877.

WE regret that we cannot say much in favour of this book. It is little more than a compilation from the popular manuals of Frankland, Miller, Roscoe, &c. The first named professor's "Lecture Notes" being drawn upon, with his leave the author tells us, somewhat largely. Dr. Kemshead, by way of gratitude no doubt, has adopted Prof. Frankland's old system of insectiform graphic notation with its rods and pegs. The author does not seem to be aware that Dr. Frankland himself has abandoned this method as being too cumbersome and confusing, and now uses simple letters and lines. The system of using thick letters for the supposed principal member of a group of elements too has, as far as we know, been given up by the majority of chemical teachers who had adopted it. It is somewhat curious, too, to see our old friends the atomicity marks appearing once more on the scene. We thought they had been buried in the Red Sea several years ago. The system of teaching, too, is one that we entirely dissent from. The author is far too fond of laying down a principle and then demonstrating or proving it by experiment, whereas the truly scientific and rational method is to perform the experiment first and then deduce the principle from it. A large number of experiments are described, but generally so meagrely that it would be impossible for a beginner to perform them. It would have been much better, for instance, to have fully described one or even two methods of making hydrogen than to have given some half-dozen ways of preparing this gas in too few words. The book undoubtedly contains an immense amount of information, and for anyone who wants to cram up chemistry by reading without bothering his head with fiddle-faddle experiments it is just the book.

Dr. Kemshead's book forms part of Collins's Elementary Science Series, but it is not at all on a par with others that we have seen belonging to the same set.

## CORRESPONDENCE.

### VOLUMETRIC ESTIMATION OF ZINC.

*To the Editor of the Chemical News.*

SIR.—In a former number of your journal (CHEM. NEWS, vol. xxxi., p. 222) I described a method for the volumetric estimation of zinc which seems to have met with some favour. I now add the following modification, which may be found useful in presence of some other metals:—Calcine the ore if necessary. Dissolve in hydrochloric acid. Let the solution cool, and neutralise with chalk. Add a solution of hypochlorite of lime, enough to peroxidise and precipitate any iron, manganese, copper, lead, cobalt, nickel. Filter, and wash the residue on the filter into a guaged flask. Take a measured sample; add about 5 to 10 per cent of strong hydrochloric acid. Boil till all free chlorine is expelled, and titrate the boiling solution with the ferrocyanide and uranium indicator, as before advised.—I am, &c.,

F. MAXWELL-LYTE,

6, Cité du Retiro, Faubourg St. Honoré,  
Paris, August 15, 1877.

**Fermentation-Products of the Refuse of Paris.**—E. J. Maumené.—From some of the fermenting heaps the author has obtained alcohol and acetic acid, but from others hydrosulphate of ammonia, and even salts of compound ammonias.—*Comptes Rendus*.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 4, July 23, 1877.

**New Researches on Electro-Capillary Phenomena**—M. Becquerel.—A continuation of the author's researches on the electro-chemical phenomena produced when two liquids capable of conducting electricity, and of reacting chemically upon each other, are separated by slits in glass tubes.

**Fixation of Nitrogen upon Organic Matters, and Formation of Ozone under the Influence of Feeble Electrical Tensions.**—M. Berthelot.—The author has observed the formation of ozone by four different reactions: the transformation of arsenious acid into arsenic acid, the conversion of iodide of potassium into iodate of potassa, the union of dry sulphurous acid and oxygen, and the formation of peroxide of silver in small quantities by the reaction of moist oxygen upon a slip of silver. This last reaction does not take place independently of electric action, and is attended with a cause of error which must be pointed out; the formation of black spots of silver sulphide formed at the expense of the small quantity of alkaline sulphide contained in the glass. Sometimes the simultaneous formation of silver sulphide at one point, and of silver peroxide at another, may be observed. They are easily distinguished by the aid of a concentrated solution of hyposulphite of soda, which dissolves in the cold the peroxide of silver without acting upon the sulphide. The fixation of nitrogen upon organic compounds takes place under the influence of five Leclanché elements, forming an open circuit. The reactions described are determined by very feeble electrical tensions, quite comparable to that of atmospheric electricity. These actions, however, are very limited, otherwise the humic matters of the soil would become rich in nitrogen rapidly.

**Note on Dr. Bastian's Experiment on Urine Neutralised with Potassa.**—M. Pasteur.—A continuation of the controversy on abiogenesis.

**Electro-conductivity of Trees.**—M. Th. du Moncel.—This paper contains an elaborate table of the resistance of different kinds of trees.

**Reply to the Observations of M. Cosson on the Project of a Saharian Sea.**—M. d'Abbadie.—An attempt to show that the submergence of the Sahara would be unattended with dangerous consequences.

**Reply to the Observations of M. Naudin on the Interior Sea of the Sahara.**—M. Roudaire.—This paper is similar in its character to the foregoing.

**The Colorado Beetle.**—M. Maurice Girard.—The author disapproves of arsenical compounds for the destruction of this insect, and recommends the sulpho-carbonate of potash in heavy doses.

**Influence of Heat upon Magnetisation.**—M. J. M. Gaugain.—M. Favé had pointed out that when a bar of steel is magnetised at about 350°, allowed to cool, and heated again, the quantity of magnetism augments, and may reach triple the value which it had preserved after cooling. M. Wiedemann maintains that a bar magnetised at an elevated temperature loses on cooling a part of its magnetism: it loses a further portion when heated again, but on cooling it resumes a part of what it had lost. The author believes that this contradiction is due to the circumstance that M. Wiedemann experimented only with bars heated to 100°, whilst M. Favé operated with bars magnetised at a far higher temperature.

**Magnetisation of Circular Plates where the Iso-dynamic Lines are Concentric Circumferences.**—M.

E. Duter.—A mathematical paper, not suitable for useful abstraction.

**Electrolysis of Sulphurous Acid.**—M. A. Guerout.—It is supposed that on the electrolysis of aqueous sulphurous acid it is resolved into sulphur and oxygen, the sulphur appearing at the negative pole and the oxygen at the positive. The process, however, is by no means so simple. If the aqueous acid is decomposed by a feeble current the positive pole presents no visible change, but it may be shown by means of chloride of barium that sulphuric acid is produced. At the negative pole there appears a yellow liquid, which is the hydro-sulphurous acid of Schützenberger. If the intensity of the current is varied nothing is observed at the + pole but a production of sulphuric acid. At the - pole the product is modified. With two Bunsen elements, beside the production of the yellow liquid, there is a deposit of sulphur on the electrode, and with three the deposit of sulphur is complete, and a yellow liquor only appears at the outset. A solution of sulphurous acid, therefore, is decomposed like a salt, the acid and the oxygen going to the positive pole, and the hydrogen to the negative pole, where it reduces sulphurous acid to hydro-sulphurous acid, which latter, by its almost instantaneous decomposition gives rise to a deposit of sulphur.

**Determination of Manganese, Nickel, Zinc, and Lead.**—M. A. Riche.

**Vapour-Densities of the Hydrosulphates of Ammonia.**—M. A. Horstmann.—The author maintains that on mixing ammonia and hydrosulphuric acid, at temperatures from 50° to 80°, and in whatsoever proportion, there is no contraction.

**Researches on the Gases contained in the Tissues of Fruits.**—M. A. Livache.—In sound fruits contained in the tissues are formed of a mixture of oxygen and nitrogen in the same proportions as in the atmosphere. If the tissues are lacerated the oxygen is rapidly transformed into carbonic acid. If such fruits are left for some time a true fermentation sets in, and there is a plentiful evolution of carbonic acid, whilst the nitrogen undergoes no change.

*Bulletin de la Societe Chimique de Paris,*  
No. 12, June 20, 1877.

**Analysis of French Wines.**—M. E. Houdart.—In determining the amount of solid residue in wines the author finds that four hours of desiccation, after the complete evaporation of 25 c.c. of wine, suffice to drive off all the water without incurring the loss of glycerin or of sparingly volatile ethers. If this time is exceeded the weight of the residual extract may be indefinitely diminished. The nature of the capsule is also of importance, whence comparable results can only be obtained by using in every experiment vessels of the same material and thickness. One and the same wine evaporated in a stout porcelain capsule gave 19.60 of residue, in a slender capsule 18.72, and in one of platinum 18.08.

**Preparation of Fluosilicate of Ammonium.**—M. F. Stolba.—The fluosilicic acid of commerce is digested with iron wire, and the solution evaporated until it deposits crystals on cooling. The boiling solution is then mixed with one-fifth its weight of a saturated and boiling solution of sal-ammoniac. The solution is let cool, the crystals are collected, washed with a little cold water, and recrystallised from boiling water.—*Archiv. der Pharmacie.*

**Transformation of Oxalate of Ammonia.**—G. Fleury.—A dilute solution of oxalate of ammonia, if preserved from the direct light of the sun, is completely converted into carbonate of ammonia in about six weeks. Hence this salt cannot be employed in the preparation of standard solutions. The oxalate of potassa is not much more stable.

**Bronze for Iron.**—M. P. Hess.—The articles to be bronzed are heated in the air after being coated with lin-

seed oil. Objects which cannot be exposed to a high temperature may be steeped in a slightly acid solution of ferric chloride, plunged in hot water, and when dry rubbed with linseed oil or with wax. To preserve iron from rust the author recommends sulphide of copper. He steeps the iron for a few minutes in a solution of sulphate of copper, and then transfers it into a solution of hyposulphite of soda acidulated with hydrochloric acid. The result is a blue-black coating, not affected by air or water.—*Deutsche Industrie Zeitung.*

**Extraction of Copper by an Acid Solution of Ferrous Chloride.**—M. A. Hauch.—To diminish the quantity of hydrochloric acid consumed in the extraction of copper from malachite, the author uses the acid solution of ferrous chloride obtained in precipitating copper from its hydrochloric solution by means of iron, as resulting from former operations.—*Oesterreich Zeitschrift für Berg. und Hüttenwesen.*

**Extraction of Silver from Cyanide Baths.**—M. de Bibra.—Baths of silver cyanide, the residues from galvanoplastic establishments, are precipitated with sulphuric acid. The precipitate contains all the silver along with copper, zinc, and iron. It is ignited, and the residue is treated with nitric acid, which dissolves out the silver, zinc, and copper. From this solution the silver is thrown down as chloride. The portion insoluble in nitric acid contains carbon, ferric oxide, and traces of silver, which may be extracted with ammonia.—*Journal für Praktische Chemie.*

*Les Mondes, Revue Hebdomadaire des Sciences,*  
No. 12, July 21, 1877.

A shower of sand is reported to have occurred at Rome on June 22. It had the usual brick-red colour of the sands of the desert, and was accompanied with filaments and granules of pollen.

The electric light is being very successfully tried in the Palais de l'Industrie at Paris, the superficial extent of which is 12,000 square metres. The light proceeds from two electric lustres of six lamps each, suspended at the height of 20 metres from the ground. At least 10,000 candles would be required for an equal illumination of the floor alone.

No. 13, July 28, 1877.

This issue contains no original chemical matter.

No. 14, August 4, 1877.

**Determination of Iodine in Mineral Waters.**—M. Eboli.—The author's process is based upon the fact that the blue colour of iodide of starch disappears completely in presence of a chloride when the iodide is brought in contact with an alkaline hydrosulphate. The hydrosulphuric solution being previously standardised we may determine in this case all the iodine of a dissolved iodide. The mode of operating consists in causing the iodine to pass into the free state, which is effected by acidifying very distinctly a known quantity of the liquid under examination with a mixture of 1 part of nitric acid and from 4 to 6 parts of sulphuric, incorporating the whole with a little starch paste. If the reaction of the starch and the iodine does not appear in consequence of the very minute quantity of the latter in a dilute liquid, a fragment of peroxide of barium is added, when the liquid takes at once a blue colour. When the development of oxygen gas, from the decomposition of the barium peroxide ceases, a known volume of a standard solution of hydrosulphate of ammonia is gradually added, stirring the liquid well with a glass spoon, and suspending this operation as soon as the solution is decolourised. If there be present in the liquid under analysis iron, manganese, or any body other than iodine capable of reacting with hydrosulphate of ammonia, such must be previously removed. As for the graduation of the solution of hydrosulphate of ammonia, 1 grm. of iodide of potassium is dissolved in a burette of distilled water: the tube

being divided into 100 degrees, it is evident that 10 of these must contain  $\frac{1}{10}$  grm. potassium iodide = 0.02356 grm. of pure iodine. A solution of hydrosulphate of ammonia is then made, as dilute as possible, say 10 c.c. of the commercial hydrosulphate in 250 c.c. of water. With this weak solution we make an experiment upon a decigramme potassium iodide, acidifying the liquid, adding starch-paste, and if needful peroxide of barium as above described, and then discharging the blue colour with the hydrosulphate solution. If, e.g., 125° of this solution have been used, these must represent 0.02356 of iodine, the quantity contained in 1 decigram. of potassium iodide. If we wish to analyse 100 c.c. of a mineral water containing an iodide, and if in the process we employ 80° of the standard solution, there must exist in the water 0.015078 grm. of iodine. If the iodine is combined with chlorine we take a further quantity of the liquid to be analysed, and precipitate both together by nitrate of silver in the ordinary manner. As we already know the quantity of iodine present in a given volume of the water, it is easy to deduct from the weight of the silver precipitate the increase of weight due to the iodide of silver. This difference gives the weight of the chloride of silver, from which the chlorine is calculated according to the formula  $Ag = 75.27, Cl = 24.73$ .

**Falsification of Butter with Animal Fats.**—M. P. Jaillard.—The author places a portion of the suspected sample between two suitable slips of glass, and examines with the microscope. If the product is pure fatty globules alone are perceived, but if it is adulterated arborescent crystallisations are perceived among the globules.

*Moniteur Scientifique, Quesneville.*  
June, 1877.

**Review of Physics.**—M. R. Radau.—This very lengthy memoir contains no original observations, and is devoted to a history of thermo-actinometers, to the action of light upon plants, and to the sensitive layer of the retina. According to the researches of Pfeffer, light which has passed through a solution of chlorophyll exerts only a very feeble action upon vegetation. Such a solution transmits the yellow rays in great part, the green, and the extreme red, but absorbs the mean red.

**Account of Foreign Researches in Chemistry.**—M. E. Nolting.—The papers here abstracted are all taken from the *Berichte der Deutschen Chemischen Gesellschaft*, and have been already noticed.

**Researches on Carbuncular Disease.**—MM. Pasteur and Joubert.—A physiological paper. The authors hold that the part played in such diseases by bacteria, &c., has been greatly exaggerated.

**Influence of a Solution of Potassa and of an Elevated Temperature on the Origin and the Development of Microphytes.**—W. Roberts.

**Behaviour of Alkalinised Urine.**—Prof. Tyndall.—These two papers are taken from the *Proceedings of the Royal Society*.

**Analysis of Pyrogenous Gases.**—M. A. Berthelot.—Already noticed.

**New Method of Determining Pure Anthracen in Crude Anthracen.**—MM. Meister, Lucius, and Brüning.—A gramme of the anthracen to be analysed is placed in a small flask containing 500 c.c., and fitted with a reflux apparatus, covered with 43 c.c. of glacial acetic acid, and heated to a boil. This temperature is kept up, and a solution of 15 grms. of chromic acid in 10 c.c. of glacial acetic acid and the same volume of water is added drop by drop. This addition is extended over two hours, and when the whole has been poured in the liquid is still heated for two hours longer, the total process of oxidation thus requiring four hours. The contents of the flask are allowed to settle for twelve hours, mixed with 400 c.c. of pure water, and allowed to subside again for three hours. The anthraquinon which has separated out is collected

on a filter, and washed first with pure water, then with boiling water rendered slightly alkaline, and then again with hot pure water. The contents of the filter are then washed into a small porcelain capsule, and dried at 100°. The dry anthraquinon is moistened in the same capsule with ten times its weight of fuming sulphuric acid, and heated for ten minutes in the water-bath. The solution thus obtained is poured into a flat capsule, and left for twelve hours in a damp place so that it may absorb moisture. At the end of this time 200 c.c. of cold water are added to the contents of the capsule, the anthraquinon which separates is again collected on a filter and washed as above, first with pure water, then with boiling alkaline water, and finally with pure hot water. It is then washed into a capsule, well dried at 400° (100°?), and weighed. The capsule is then heated till the anthraquinon is completely volatilised, and is then weighed a second time with the ash and the residual carbon. The difference between the two weights gives the quantity of anthraquinon, from which the weight of pure anthracen is readily calculated.—*Zeitschrift für Analytische Chemie*.

*Reimann's Färber Zeitung,*  
No. 28, 1877.

**Detection of Turmeric in Flavin.**—Flavin is now, it appears, often adulterated with turmeric. To detect this fraud a portion of the suspected sample is boiled with about twenty times its weight of water, the liquid is strained, and a bit of cotton yarn is plunged into the clear hot solution. If it takes a yellow colour turmeric is present, as flavin is very sparingly soluble in water.

## MISCELLANEOUS.

**British Association for the Advancement of Science.**—The following are the names of the Officers and Committee of Section B (Chemical Science Section) of the Plymouth Meeting of the British Association:—

**President**—F. A. Abel, F.R.S., Past President of the Chemical Society.

**Vice-Presidents**—Dr. Gladstone, F.R.S.; A. Vernon Harcourt, F.R.S.; Dr. Longstaff, F.R.S.; Prof. Odling, F.R.S.; W. H. Perkin, F.R.S.; Dr. Russell, F.R.S.; H. C. Sorby, F.R.S.; Prof. Williamson, F.R.S.

**Secretaries**—Dr. Oxland; W. Chandler Roberts, F.R.S.; John M. Thomson.

**Committee**—Capt. Abney, F.R.S.; Prof. Attfeld; Prof. Atkinson; A. Allen; J. T. Bottomley, M.A.; P. Braham; Wm. Lant Carpenter, B.Sc.; Dr. Dupré, F.R.S.; T. Fairley; A. E. Fletcher; Prof. Cary Foster, F.R.S.; Lieut.-Col. Gamble; George Gladstone; Dr. S. A. Goldschmidt; J. G. Gordon; Prof. Guthrie, F.R.S.; C. T. Kingzett; Dr. Macadam, F.R.S.E.; Prof. Macleod; J. Maclear; A. J. Moss; E. W. Parnell; Dr. B. H. Paul; J. A. Phillips; J. Smith, jun.; Sylvanus Thompson, B.Sc.; W. Thomson; C. R. C. Tichborne, Ph.D.; F. H. Varley, C.E.; Dr. John Watts; W. Weldon, F.R.S.E.; W. Charlton Williams; John Williams; T. Wills; C. J. Woodward; P. Worsley; Dr. C. R. Alder Wright.

The papers brought before the Section were as follows:—

**W. N. Hartley.**—Report of the Committee for Investigating Conditions under which Liquid Carbonic Acid Exists in Rocks and Minerals.

**E. M. Dixon.**—Report of the Committee for the Quantitative Estimation of Atmospheric Ozone.

**W. H. Watson.**—On the Action of various Fatty Oils on Copper.

**J. Maclear.**—On a New System of Alkali Manufacture.

**A. H. Allen.**—Report of Committee on Commercial Phosphates and Potash Salts.

**Professor Barff.** (Communicated by Dr. W. J. Russell.)  
—On the Formation of the Black Oxide of Iron on Iron Surfaces, for the Prevention of Corrosion.

- Professor Gladstone*.—On some Candles Altered by long Exposure to Sea Water.
- T. Wills*.—On the Coal brought home by the late Arctic Expedition.
- Dr. C. Alder Wright*.—Contributions to Chemical Dynamics.
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- Dr. John Watts*.—On Pyrocatechin as a Derivative of Certain Varieties of Tannic Acid.
- A Vernon Harcourt*.—On the Application of a New Unit of Light to the Examination of Coal Gas.
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- T. A. Readwin*.—Note on some Recent Changes of Gold Surfaces.
- T. A. Readwin*.—On some recent Gold Pseudomorphs.

The meeting of the British Association for 1878 will be held at Dublin under the Presidency of Mr. William Spottiswoode, LL.D., F.R.S. The Vice-Presidents chosen are the Lord Mayor, the Provost of Trinity, the Duke of Leinster, Earl Rosse, Lord O'Hagan, and Professor Stokes. The meeting for 1879 will be held at Nottingham.

### TO CORRESPONDENTS.

*Mr. Allen and M. Kern*.—M. Kern writes to say that as he is not very conversant with the English language most of his papers were written by another person, and errors may in this way have crept in. Bunsen may, as Mr. Allen states, have pointed out the probability of the existence of a new metal in the platinum group, but that does not prohibit him (M. Kern) from laying claim to the discovery of "Davyum."

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# THE CHEMICAL NEWS.

VOL. XXXVI. No. 927.

## ON THE OCCURRENCE OF OXALIC ACID IN FUNGI.

By WILLIAM M. HAMLET, F.C.S., and  
CHARLES B. PLOWRIGHT, M.R.C.S.

THE object of the present paper is to record a few facts which came under the observation of the authors while engaged in the study of the part played by cryptogamic plants in the economy of nature.

These beautiful and interesting plants appear to be not only intermediate organisms between amorphous decaying vegetable matter on the one hand and the higher forms of vegetable life on the other, but are capable of serving as carriers of nutriment from one phase of plant life to another. Especially is this the case in the process of decay by oxidation termed by Liebig *eremacausis*, in which the existence of some fungi would appear to contribute in no small degree to render soluble compounds which previously existed in forms less easily assimilated. Thus it seems probable that the decay of the fungus effects a change which we may compare to that of the artificial manure manufacturer, whose object is to render soluble forms of matter which were previously insoluble.

As the varied and characteristic properties of different fungi became better known, no doubt by their effect on the human subject, they were generally classed into "poisonous" and "edible," but such a classification, by no means well marked, was very imperfect owing to ignorance of their properties.

Through the indefatigable labours of the mycologist we have become acquainted with their acrid nature, behaviour with tincture of iodine, decomposition, action of heat in cooking, which renders some of the so-called poisonous ones edible, and many other changes, not to mention several analyses which from time to time have appeared.

Greville in his "Scottish Cryptogamic Flora," vol. iii., plate 113, under *Polyporus sulphureus*, mentions the fact that Prof. Thompson found crystals of hydric potassium oxalate in a plant of this species, and Dr. R. Scott (*Trans. Linn. Soc.*, viii., 268) also discovered oxalic acid in the same species. And more recently De Bary (*Morph. und Phys. der Pilze*, pp. 13, 14) regards calcium oxalate as a common constituent of fungi.\*

In the early part of last summer some fine specimens of *Peziza venosa*, Pers., were noticed by us to give a strong acid reaction to test-paper; on several other occasions both previous and subsequent we found a large number of Agarics and Polypori to be decidedly acid. Opportunities for further research were presented when during the summer and autumn a large number of *Hymenomycetes*† were found to have the same reaction in a greater or less degree, which in every instance was distinct and permanent. It was not, however, confined to the *Hymenomycetes*, for the *Lycoperda*, *Pezizæ*, and *Sphæriæ* gave a similar acid reaction.

The question naturally presented itself as to what free acid or acid salt could be so widely distributed in the fungus kingdom.

To solve this problem a number of species were exhausted with pure water, filtered, and the filtrate examined qualitatively for acids, whereupon in every case a marked

reaction for oxalic acid was obtained. In solutions to which a few drops of dilute acetic acid had been added, or solution made alkaline by ammonia, upon the addition of some solution of calcium chloride, a fine white precipitate was produced, which, on drying, gently heating, and treating with hydrochloric acid, effervesced, liberating carbon dioxide. Argentic nitrate gave a white precipitate soluble in nitric acid; barium chloride gave also a white precipitate, entirely dissolved by dilute hydrochloric acid.

To the solution, made neutral with very weak ammonia, was added solution of auric chloride, and a finely divided precipitate of metallic gold was obtained. The presence of oxalic acid was therefore established beyond doubt.

From amongst a great number of experiments one of the most remarkable examples of strong acidity was that of *Fistulina hepatica*; having in this case been fortunate enough to possess a large supply of this fungus, an estimation of the amount of free acid present as well as a gravimetric estimation of the oxalic acid by the lime-process were alike desirable. Accordingly 14.3808 grms. of the *Fistulina* were taken and digested with pure water for twenty-four hours; the solution filtered and the residue washed with pure water until the liquid passing through ceased to show acid reaction.

To the clear and port wine-coloured solution was gradually added some decinormal solution of sodium hydrate, the final point of saturation being ascertained by very sensitive neutral litmus paper. The quantity of alkali required was 1.9 c.c. which corresponds to 0.01197 gm. of  $H_2C_2O_4 \cdot 2OH_2$ , equal to 0.083 per cent of free acid.

In order to verify the result thus obtained by the process of alkalimetry, 50 grms. of the fungus were cut into small pieces by means of a platinum knife and thoroughly exhausted with pure water on two large filters in connection with a Bunsen pump. The filtrate, together with the washings, were reduced by evaporation to about 100 c.c., rendered alkaline by dilute ammonia, and solution of calcium acetate added in excess. The calcium oxalate was filtered and well washed, dried on a weighed filter at 100° C. until constant.

50 grms. gave 0.0455 gm.  $CaC_2O_4 \cdot OH_2$ , which, calculated to percentage, shows 0.078 per cent of oxalic acid. We have then:—

	Per cent.
By alkalimetry .. .. .	0.083
By estimation as calcium oxalate (dried at 100°)	0.078

A complete analysis of this interesting plant was in progress, but from deficiency of material and loss by accident was wholly arrested, and is deferred for another opportunity. An idea of its composition may be gathered from the unfinished analysis.

### Proximate Analysis of F. Hepatica.

Water .. .. .	86.120
Volatile* constituents	Oxalic acid .. .. . 0.08
	Fat .. .. . 0.15
	Woody fibre (cellulose) 2.03
	Mycose .. .. .
	Extractive matter .. ..
Mineral* constituents (ash).	Resin .. .. .
	Silica .. .. .
	Ferric oxide .. .. .
	Lime .. .. .
	Magnesia .. .. .
	Potash .. .. .
	Phosphoric acid .. ..
	Sulphuric acid .. ..
	Chlorine .. .. .
	100.000

\* Found qualitatively.

A large number of specimens were examined qualitatively, and we discovered the presence of oxalic acid or oxalates in the following species:—

\* But beyond this we believe no suspicion existed in the minds of mycologists of the extent to which the free acid or its compounds were present in the group of cryptogams.

† All the *Hymenomycetes* on the table at the Woolhope Fungus Meeting, held at Hereford in October, 1876, were examined and found acid to litmus paper without exception.

Agaricus (*Amanita*) *phalloides*, *Fr.*  
 Agaricus (*Amanita*) *rubescens*, *Pers.*  
 Agaricus (*Amanita*) *vaginatus*, *Bull.*  
 Agaricus (*Lepiota*) *procerus*, *Scop.*  
 Agaricus (*Clitocybe*) *maximus*, *Fr.*  
 Agaricus (*Clitocybe*) *laccatus*, *Scop.*  
 Agaricus (*Mycena*) *galericulatus*, *Scop.*  
 Agaricus (*Hypoloma*) *appendiculatus*, *Bull.*  
*Lactarius rufus*, *Fr.*  
*Lactarius torminosus*, *Fr.*  
*Lactarius subdulcis*, *Fr.*  
*Russula vitellina*, *Fr.*  
*Cantharellus cibarius*, *Fr.*  
*Cantharellus aurantiacus*, *Fr.*  
*Panus torulosus*, *Fr.*  
*Boletus luteus*, *Fr.*  
*Boletus scaber*, *Fr.*  
*Polyporus betulinus*, *Fr.*  
*Polyporus rufescens*, *Fr.*  
*Polyporus farinellus*, *Fr.*  
*Fistulina hepatica*, *Fr.*  
*Lycoperdon giganteum*, *Batoch.*  
*Lycoperdon gemmatum*, *Fr.*  
*Leotia lubrica*, *Pers.*  
*Peziza venosa*, *Pers.*  
*Peziza rutilans*, *Fr.*

From these and other facts before us we conclude that all mature non-microscopic fungi contain oxalic acid either in the free state or in combination with the alkalies or metals of the alkaline earths. And although much has been done during the last few years upon the composition of fungi, yet it has been chiefly confined to their ultimate analysis or to the analysis of the ash; it is therefore hoped that these few notes upon the proximate compounds, which enter into their composition may not be without some interest to the scientific world.

NOTE.—We might here mention that we found oxalic acid in *Oxalis corniculata*; from the beautiful violet solution obtained by treating the stem and leaves of this plant with pure water, a very copious precipitate was obtained on adding solution of calcium chloride or acetate. Most of the text-books mention the fact that oxalic acid is found in the wood sorrel (*Oxalis acetosella*) *Rumex acetosa*, *R. acetosella*, common rhubarb (*Rheum*), as well as in many lichens.

## REPORT

ON THE

## DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.\*

By Dr. A. W. HOFMANN.

(Continued from p. 5.)

*Manufacture of Sulphuric Acid.* By ROBERT HASENCLEVER, Manager of the Stolberg Works.

THE hot gases from the pyrites kilns are often used for the concentration of sulphuric acid. In this case the leaden pans are placed above or behind the kilns or the sulphurous acid from the furnaces is passed into a lead tower filled with hard burnt bricks. The arrangement of pans upon the kilns has the disadvantage that if they leak the escaping acid destroys the furnace. It has repeatedly occurred that in cases of such construction the manufacture of sulphuric acid has had to be suspended at the end of the year, and the pyrites kilns entirely rebuilt. It is preferable to place the pans behind the furnace and to construct a subsidiary flue connecting the kilns with the chamber, so that if repairs in the pans become requisite the manufacture of sulphuric acid may still go on without interruption.

A much better utilisation of the hot sulphurous acid for the purpose of concentration is effected in Glover's tower, which was first introduced in England, and has been described in full by Lunge.\* The so-called Glover's tower consists of a leaden chest 4 to 8 metres in height, and of 6 to 10 square metres in superficial extent. For the preservation of the lead it is lined internally with a layer of stones, and is filled with coarse fragments of sandstone or bricks. These materials must be so selected as to resist the action of hot sulphuric acid. Whilst the hot gases from the kilns enter from beneath they escape at the top in a cooled condition, and are conducted at once into the chambers. Sulphuric acid of sp. gr. 1.5 flows in constantly from above (either alone or simultaneously with the nitrous acid from the Gay-Lussac tower). It is distributed in the tower, comes in contact with the hot sulphurous acid, and escapes below at the sp. gr. of about 1.7. This admirable arrangement was quickly adopted in France and Germany, and has everywhere given satisfactory results. By the direct action of the hot furnace gases upon the sulphuric acid, as it occurs in Glover's tower, a powerful evaporation is effected; the sulphurous vapours arrive cooled into the chambers, where the sulphuric acid which evaporates in the tower is likewise arrested, add as the watery vapour which escapes is also conducted into the chambers there is an economy of steam. Occasionally it has happened that the Glover's tower has been charged with a material so powerfully attacked by the hot acid that the apparatus has been totally choked up and has ceased to act. Another evil involved in the application of Glover's system consists in the fact that no satisfactory arrangements can be made to arrest the flue-dust, since the gases would be too much cooled. Thus the flue-dust is conveyed into the acid, which thus becomes contaminated with iron. For the production of common salt-cake, to be afterwards converted into soda, for the manufacture of superphosphate, &c., the acid concentrated in Glover's tower is perfectly suitable. But the process is less to be recommended for the preparation of sulphuric acid for sale, or for use in the manufacture of salt-cake for the makers of white glass.

The Glover's tower not merely effects the concentration of the chamber acid, but also the denitrification of the acid from the Gay-Lussac tower as already explained.

The further concentration of the acid from 60° to 66° B. is sometimes carried on in vessels of glass, but more commonly in those of platinum. The author has not met with any accurate statements of the outlay for glass, fuel, and labour for concentrating the acid up to 1.840, but according to communications from English manufacturers the cost is considerably greater than for platinum vessels.†

Attempts have been made to render the process of evaporation in glass retorts continuous, but the results of the platinum apparatus are still more favourable. Scheurer Kestner‡ estimates the loss of platinum at 2 grms. per ton of sulphuric acid. In a letter to A. W. Hofmann he gives the details of the loss, and states that accurate observations have been made at Thann during three portions of time. From 1854 to 1856, when the sulphuric acid contained a small quantity of sulphurous acid, 1.92 grms. of platinum were dissolved per ton of sulphuric acid of sp. gr. 1.840. From 1856 to 1862 the chamber acid contained nitrous acid, and 2.52 grms. of platinum were dissolved per ton of acid at 1.840. From 1862 to 1866 sulphurous acid was present, and the amount of platinum dissolved was 1.05 gm. per ton of acid of the same strength.

The chemical works at Hautmont (Department Nord) procured in 1865 a platinum apparatus holding 150 litres and weighing 28,548 grms. In 1870 the apparatus was repaired in Paris, when 7891 grms. of platinum were used, but 6275 grms. of old platinum were allowed for, and the weight of the apparatus by the addition of 1616 grms. was increased to 30,164 grms. At the end of 1873 the ap-

\* Lunge, *Dingl. Pol. Journ.*, cci., 341.

† See note below.

‡ Scheurer Kestner, *Comptes Rendus*, lxxiv., 1286.

\* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

paratus weighed 28,452 grms., showing a loss of 1712 grms. During nine years working 6796 tons of sulphuric acid of 1.840 sp. gr. had been prepared in the apparatus. The loss of platinum was therefore 0.252 gm. per ton of sulphuric acid. The apparatus cost 30,588.40 francs at 1050 francs per kilo. The repairs in 1870 cost 3439.95 francs, together 34,028.35 francs. The worn-out apparatus was sold at 810 francs per kilo. = 23,046.12 francs. The expenditure was therefore 34,028.35 - 23,046.12 = 10,982.23 francs, or per 1000 kilos. sulphuric acid at sp. gr. 1.800 1.616 francs, or about 1s. 3½d.

(To be continued.)

## ON A WATER JET AIR-PUMP.\*

By J. W. SWAN.

As a supplement to the communications which have been made to the Society during the present session on the subject of aspirators, I exhibit one more form of this useful little instrument. There have been proposed so many slight variations of the form of the water jet aspirator, all alike in principle, and many very nearly alike in form, that I really do not know precisely what amount of novelty there is in the jet now exhibited. But I know that many experiments have been necessary in order to arrive at the degree of perfection of action which is attained in this particular form. A very slight difference in the form of the jet greatly alters the result. You will observe that this jet differs from Mr. Procter's in being all made of glass, and of one piece of glass; therefore there is nothing to go wrong through the shifting of parts, and it is moreover producible at small cost.

It acts very rapidly, and with a head of water, such as the water-pipes usually supply, the mercury gauge quickly rises to 28½ inches.

It is of course applicable to all the uses to which Bunsen's filter pump is put, the regulator mentioned in Mr. Procter's paper being employed to govern the degree of exhaustion if necessary. I think it would also find a useful place in chemical works and in pharmaceutical laboratories, where comparatively small drying and evaporating operations requiring some approach to a vacuum are often carried on. I think its use might even be extended to almost all the lecture-table and class-demonstration experiments usually performed by the help of the common air-pump with the advantages of great saving of labour and in the cost of apparatus.

## ON HARDENED GLASS FOR LABORATORY PURPOSES.\*

By J. W. SWAN.

"To supply me with flasks and beakers, almost as resistant of the destructive agencies of fire and hard knocks as cast-iron." That was the attractive proposal made to me a few days since by the representative of a company now working M. de la Bastie's process for hardening or tempering glass. Samples were provided, not of flasks and beakers, but of other vessels that would sufficiently illustrate their properties. I immediately, and with great eagerness, gave myself up to experiments with some of the vessels. Some of them are here to-night, and are at the service of the members for the purpose of experiment. The result of my experiments are at least interesting. I found that even in a very thick basin water might be boiled, by means of a naked flame strongly playing upon it, without fracture; that the hot vessel

might, without harm, be lifted off the stand with cold tongs and set upon a cold plate of iron; that altogether it bore an amount of ill-usage that was extraordinary. Then I thought I would subject it to a severer test; I therefore only partly filled the basin, and allowed the flame to play upon a larger surface of the glass than was covered by the liquid, so that the margin of the basin might be heated above the boiling-point. I did this with the idea that probably under those conditions the temper of the glass might alter or be destroyed where the glass was more strongly heated, and if it was destroyed, that fracture would almost certainly result. The agent of the company said no, but the fragments—the results of two experiments of exactly the same kind—say yes. The character of the fracture is worthy of attention; you will observe that the bottom, which was covered by the water, is broken in small pieces like hardened glass, and that the rim has broken in larger pieces with sharp-cutting angles—in fact, like ordinary untempered glass. Possibly tempered glass may in some instances prove useful in the laboratory—for the much-abused water bottle for example—but for general purposes of the analyst, in place of flasks and beakers of thin glass, the experience which I have so far had of it, makes me very doubtful of its utility.

## SOME NEW ACID AMMONIUM SULPHATES

By PAUL SCHWEITZER, Ph.D.

IN the course of an investigation into the methods of determining sulphuric acid, I subjected ammonium sulphate to various degrees of heat and noted the loss which it sustained by decomposition; certain regularities were thereby observed, which led me to determine the quantity of sulphuric acid in the products obtained, from which I deduce the existence of at least one new compound of ammonium and sulphuric acid.

Neutral ammonium sulphate, exposed to a moderate degree of heat, loses at first quietly and without effervescence, one-half of its ammonia; and then, with rising temperature and under lively effervescence, an additional fourth of ammonia and of sulphuric acid. In the former case the requisite temperature is a little higher than the boiling-point of mercury, and the mass of a pasty and viscous condition; in the latter case below incipient red heat, and the mass a thin mobile liquid in a lively state of effervescence; both conditions are easily observed and products obtained of a uniform composition; in fact, in the latter case, the mass may be cooled at any time before complete volatilisation, and furnish the salt in question. Both salts present, after cooling, crystalline masses of greater toughness but inferior hardness than melted potassium bisulphate, to which they bear a general resemblance; they absorb water but slowly, and ammonia from a dry atmosphere with extreme reluctance.

1.  $(\text{NH}_4)_2\text{SO}_4$ , *Ammonium Sulphate*.—The salt employed was pulverised and dried at 100° C., and contained in 1.5081 gr. = 2.6728 grs.  $\text{BaSO}_4$  = 0.9177 gr.  $\text{SO}_3$  = 60.8514 per cent, and may be supposed to have been pure, as theory would require 60.6061 per cent of  $\text{SO}_3$ .

2.  $\text{NH}_4\text{H.SO}_4$ , *Ammonium Bisulphate*.—The previous salt was heated until the thick pasty mass ceased to give off ammonia, when it was analysed, yielding in 1.7930 gr. = 3.6130 grs.  $\text{BaSO}_4$  = 1.2403 gr.  $\text{SO}_3$  = 69.1746 per cent. It was then heated for fifteen minutes longer, when it gave on analysis in 1.9267 gr. = 3.9004 grs.  $\text{BaSO}_4$  = 1.3390 gr.  $\text{SO}_3$  = 69.4971 per cent. No change had taken place in the composition of the substance by the second heating, which is proof, I think, of the existence of a stable compound. The acid sulphate requires by theory 69.5652 per cent of  $\text{SO}_3$ .

3.  $(\text{NH}_4)_2\text{H}_4(\text{SO}_4)_3$ , *Biammonium Tetrahydrogen Sulphate*.—The remainder of the previous salt was heated higher, until effervescence set in and 3 grs. had been

\* Read before the Newcastle-upon-Tyne Chemical Society, March 22, 1877.

volatilised off; it gave on analysis in 1.2159 gr. = 2.5681 grs.  $\text{BaSO}_4 = 0.8818$  gr.  $\text{SO}_3 = 72.5224$  per cent. The rest was heated a second time, until another 3 grs. had been volatilised, when the remainder was analysed, giving in 0.8637 gr. = 1.8353 gr.  $\text{BaSO}_4 = 0.6301$  gr.  $\text{SO}_3 = 72.9536$  per cent.

There is no difference in the two results, which agree closely with the percentage of sulphuric acid in a more acid ammonium sulphate, which if of the above formula, requires 73.1717 per cent of  $\text{SO}_3$ . There was no trace of sulphurous acid found in the salt.

The reactions, according to which the two salts are probably obtained, are these:—

1.  $(\text{NH}_4)_2\text{SO}_4 = \text{NH}_4\text{H.SO}_4 + \text{NH}_3$ .
2.  $4(\text{NH}_4\text{HSO}_4) = (\text{NH}_4)_2\text{H}_4(\text{SO}_4)_3 + \text{SO}_2 + 2\text{H}_2\text{O} + \text{N}_2 + \text{H}_4$ .

Of other analyses made of products obtained by the application of a lower degree of heat, I mention two more, which correspond to a salt of the formula  $(\text{NH}_4)_4\text{H}_2(\text{SO}_4)_3$ , which requires 66.2983 per cent of  $\text{SO}_3$ , without, however, having verified the existence of this salt by additional experiments. It occupies about the relative position to the preceding salt that neutral ammonium sulphate occupies to the ordinary bisulphate; these are the figures: 2.1739 grs. = 4.1934 grs.  $\text{BaSO}_4 = 1.4396$  gr.  $\text{SO}_3 = 66.221$  per cent. 1.4495 gr. = 2.8077 grs.  $\text{BaSO}_4 = 0.9639$  gr.  $\text{SO}_3 = 66.499$  per cent.

Ammonium bisulphate, placed under a bell-jar with a vessel containing water, increased in weight by absorption in the following ratio:—

1.3896 gr. $\text{NH}_4\text{HSO}_4$ .	
1.0439 „	= 3.159 per cent after 24 hours.
0.1089 „	= 7.837 „ „ two days.
0.1387 „	= 9.981 „ „ three „

Another sample, placed in an atmosphere of ammonia, generated from a mixture of sal-ammoniac and slacked lime, increased in weight in the following manner:—

2.1251 grs. $\text{NH}_4\text{H.SO}_4$ .	
0.0024 gr.	= 0.113 per cent after 24 hours.
0.0030 „	= 0.141 „ „ two days.
0.0038 „	= 0.179 „ „ three „

—*American Chemist.*

State University of Missouri.

## ON THE DETERMINATION OF MANGANESE, NICKEL, ZINC, AND LEAD.

By M. A. RICHE.

THE author has shown that copper may be determined with the greatest accuracy by the action of the battery in a nitric solution, and it is also by the electric current that he proposes to determine the four metals above mentioned.

### I. Manganese.

(a.) If the liquid only contains this metal as a sulphate or nitrate it is submitted to the action of a Bunsen element, if the manganese is in small quantity, or of two elements. The operation is performed in a platinum crucible, placed in a water-bath at from  $70^\circ$  to  $90^\circ$ . The manganese is deposited in the state of peroxide upon the crucible, which acts as the positive pole; the negative pole is a spiral of platinum. When the manganese has disappeared from the liquid it is decanted upon a filter, which is washed and incinerated in the weighed crucible: 250 milligrms. of oxide are deposited in five hours. The separation would be slower in the cold, when three elements may be employed: 750 milligrms. are deposited in eight hours.

(b.) Manganese is determined quite as accurately in presence of copper, nickel, cobalt, zinc, magnesia, alu-

mina, and alkaline and alkaline-earth metals. The manner of operating in these various cases may be seen in the author's memoir. Manganese cannot be determined when accompanied with a large proportion of iron. The peroxide is reduced to a salt of protoxide, which remains in solution. In this case the iron is thrown down by carbonate of baryta, and the filtrate is then submitted to the current.

### II. Nickel.

The author has frequently used the battery in the analysis of the ores of New Caledonia containing nickel, magnesia, and often copper and manganese. The nickel is generally determined by precipitation in an ammoniacal liquid, but the metal often carries down magnesia at the negative pole. This is got rid of by dissolving the deposit in nitric acid, expelling the latter by sulphuric acid, and exposing the liquid to the current from two elements, which precipitates the nickel in a state of purity.

### III. Zinc.

(c.) The substance is dissolved in sulphuric or nitric acid, and saturated with ammonia, so as to re-dissolve the precipitated oxide, and acetic acid is added in excess. The solution exposed in the cold to the action of two elements gives a very adhesive deposit upon the negative pole, which is formed of a cylinder or a sheet of platinum, previously tared.

(d.) An assay of brass may be made in a few hours by this means. The liquid, hot, is submitted to the action of a single element, when the copper is deposited alone upon the negative pole. This is removed, the iron is precipitated in the liquid by ammonia, and in the filtrate the zinc is deposited as just described by two elements. One-tenth of a milligram. is deposited in a few moments.

### IV. Lead.

(e.) If this metal is alone in a nitric solution it is exposed, either cold or hot, to the action of one element. The peroxide of lead is entirely deposited in a very adhesive layer upon the crucible which forms the positive pole. The liquid is syphoned off without arresting the current, and replaced with water, which is decanted two or three times, and the tared crucible is dried at  $110^\circ$  and weighed. 400 milligrms. are deposited in five hours, and 2 grms. in one night. The lead from a liquid containing not more than one-fiftieth milligram. may be distinctly seen precipitating upon the sides of the crucible.

(f.) Lead is determined with the same exactitude in presence of large proportions of silver, iron, zinc, nickel, cobalt, alumina, magnesia, and the alkaline earths and alkalies. The assay of bronzes, alloys ordinarily containing tin, copper, and small quantities of zinc, lead, and iron, becomes—when based upon the facts pointed out above—a rapid operation where three of these metals are determined without filtrations or evaporations by weighing a sheet of tared platinum. The metastannic acid having been separated, the copper and the lead are thrown down together by a single element, the iron is precipitated by ammonia, and the zinc is determined in the filtrate by the aid of two elements.

The author is at present occupied with the assay of German silver.—*Comptes Rendus.*

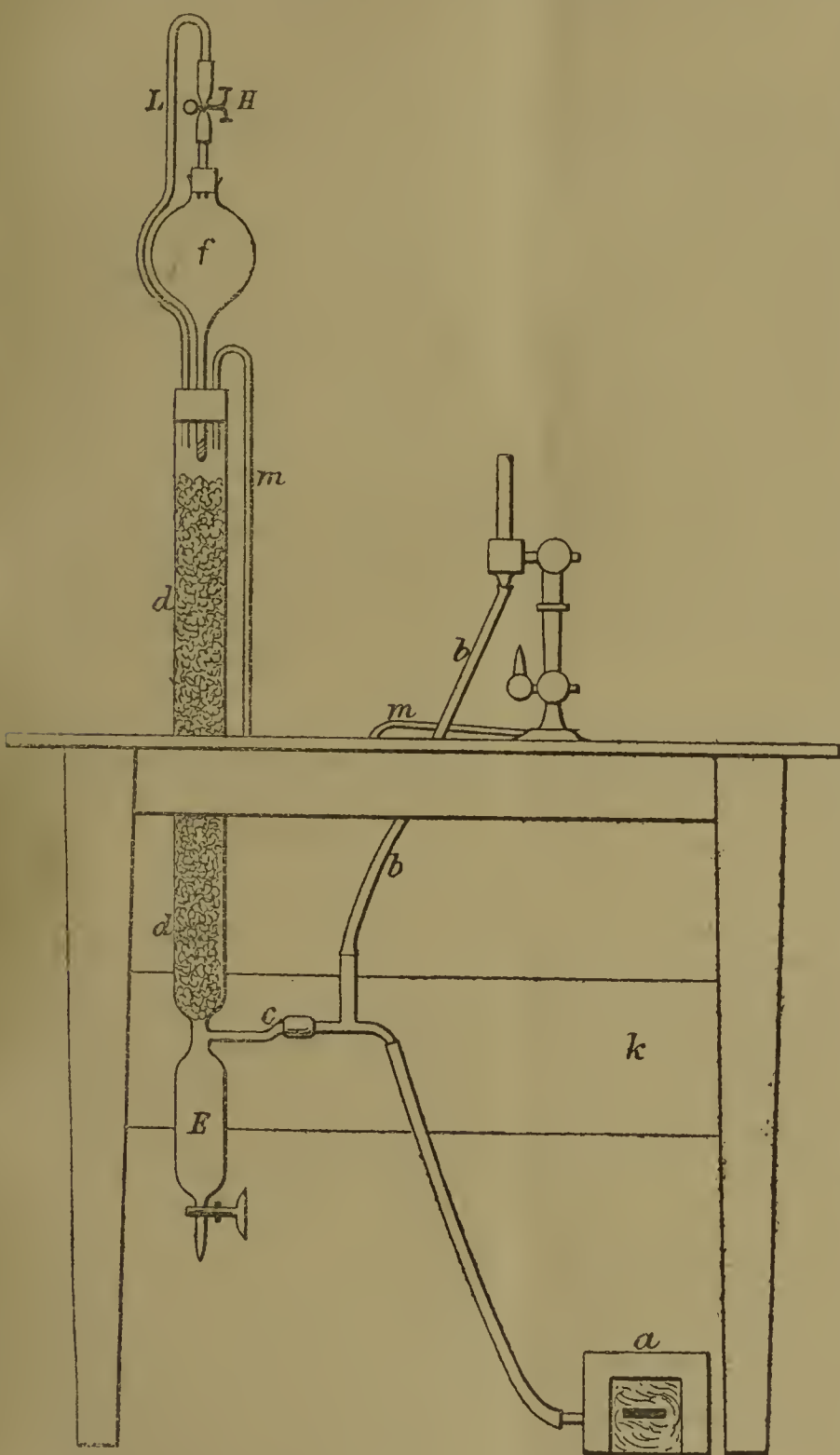
Proportion of Carbonic Acid in the Atmosphere.—  
Prof. Franz Farsky.—As the mean of 295 determinations the author gives the proportion of carbonic acid as 3.43 vols. in 10,000 of air. This figure is lower than those found by De Saussure and J. Boussingault, but higher than the results obtained by Schultze, Henneberg, Fittbogen, and Hässelbarth. The most numerous fluctuations were observed in November, December, February, March, and April, and the fewest in October. All meteorological conditions were registered along with each observation.—*Biedermann's Central-Blatt.*

# GAS GENERATOR FOR USE IN CONNECTION WITH A BLOWPIPE.

By ALEX. C. THOMSON.

THE following sketch of a gas generator for use in connection with a blowpipe will prove very serviceable in laboratories not supplied with gas.

*a* is an ordinary foot bellows; *b*, branch tube for supplying air to blowpipe; *c*, air tube leading into ditto; *d*, wide glass tube filled with pumice stone; *f*, reservoir containing a light liquid hydrocarbon, the lower tube being



drawn to a point and stuffed with a little sponge to allow discharge only by drops into *d*; *H*, clip for stopping discharge of liquid; *L*, tube to equalise pressure on both surfaces of liquid; *E*, reservoir to catch excess of liquid; *M*, tube leading off air charged with inflammable vapour; *K*, wooden support fixed to table.

A light mineral naphtha obtained from the coke towers of paraffin oil works is exceptionally suitable as a source of gas.

Those who can do a little glass blowing may construct the whole thing at a cost not exceeding three shillings, exclusive of the ordinary blowpipe fittings, and not inferior to a blowpipe supplied with coal-gas in the ordinary way.

Kincardine Castle, near Auchterarder,  
July 30, 1877.

## NOTICES OF BOOKS.

*A Manual of Inorganic Chemistry.* Vol. II.; the Metals. By T. E. THORPE, Ph.D., F.R.S. Professor of Chemistry in the Yorkshire College of Science, Leeds. New Edition. London and Glasgow: W. Collins, Sons and Co.

CHEMICAL manuals which present neither new facts nor original generalisations have been of late so numerous as to constitute the dread of the scientific reviewer. We must, however, assign a high place in its class to the work before us. We have found in its pages nothing which can be considered inaccurate, and it would be very difficult either to compress a greater amount of information in as brief a compass or to make a more judicious selection of matter. The rarer and more recently discovered metals are included in the plan of the work, and even gallium has received a notice, though not mentioned in the index or in the table of contents. The ores of the various metals, the places of their occurrence, the processes for their extraction, and their leading practical applications, are noticed, as well as their chemical and physical properties. The work is also abundantly illustrated with sketches of furnaces and other metallurgical plant, and with representations of crystalline forms.

The introduction, besides the usual exposition of the doctrine of elementary quantivalence, and well-written chapters on spectral analysis, on electro-chemical decomposition, and on crystallography, contains an exposition of Mendeleeff's law of periodicity, which is now evidently beginning to attract the attention which it deserves. There is also a brief but lucid explanation of the relations of chemical affinity to heat—a subject now becoming of great importance, yet often overlooked in books intended for the use of students. The classification adopted by the author is based upon their quantivalence, monads, dyads, &c. Arsenic he places among the non-metallic elements. We have always considered that both the Council and the Students of the Yorkshire College of Science are to be congratulated on their having secured the services of so sound and accurate a chemist as Professor Thorpe, and the present volume gives us no reason to alter our opinion.

*New Observations on Hay-Fever, with New Experiments on the Quantity of Ozone in the Atmosphere.* By C. H. BLACKLEY, M.D., M.R.C.S. London: Baillière, Tindall, and Cox. Manchester: Tubbs and Brook.

HAY-FEVER, which many men of the old school consider as a mere imaginable malady, is now attracting much attention. The author examines the various theories formed to account for its origin, and pronounces that it cannot be possibly due to heat, to light, or to ozone, but is produced by the action of pollen coming in contact with the respiratory organs. He considers that 0.0000245 of a grain inhaled in each twenty-four hours suffices to bring on the malady in its mildest form. On the other hand, 0.00029 grain, or rather less than  $\frac{1}{3427}$  of a grain in each twenty-four hours, will keep up hay-fever in its severest form. The author refers to an improved method of preparing iodised starch-papers for ozonometric purposes, and promises to explain the method of preparing it on some future occasion.

*Our Sun, from a Physical, a Philological, and a Mythological Point of View.\** By Dr. SCHMIDT. Heidelberg: C. Winter. London: Trübner and Co.

THIS author considers it manifest beyond doubt that the sun is a cold body like our earth. Its rays only receive their luminous and calorific power when their rapid motion in space is arrested by the attraction of other heavenly bodies, such as our earth and its sister-planets. Light

\* Unser Sonnenkörper nach seiner Physikalischen, Sprachlichen, und Mythologischen Seite hin Betrachtet.

he considers to be a liquid like water. He maintains that the amount of ozone in the atmosphere is connected with the decreasing proportion of its hydrogen and nitrogen, and that ozone and light increase simultaneously. Light and heat are produced by the combination of the hydrogen clouds of the sun with the ozone and the NH of our atmosphere. We must here remark that NH is a compound not yet shown to exist in our atmosphere, and further information concerning its properties would be welcomed by chemists. This same light and heat are, however, partially consumed (*verzehrt*, literally, "eaten up") by the nitrogen and hydrogen of terrestrial bodies. The earth also, it appears, gives off magneto-electric clouds of the composition HFe.

After having expounded these views in a few pages, the author adjourns to the regions of philology and mythology, where we must decline to follow him, and where some of our readers may possibly think he will be more at home.

*Trade Report for April, 1877.* By GEHE and Co., of Dresden.

A price-list of drugs and chemicals, with remarks on their relative consumption and production in different countries, and a prefatory essay on the general stagnation of trade and its causes.

*An Architect's Letter about Sewer-Gas and House Drainage.* By HENRY MASTERS. London: E. and F. N. Spon.

THE author describes and figures his method of protecting houses from the nuisance—often deadly and always offensive—of sewage-gas. It would be exceedingly difficult to give an intelligible description of his arrangements without the aid of the accompanying illustrations, but on careful examination we consider them eminently judicious. One point, however, he does not seem to notice. No sewer should be allowed to pass beneath the floor of a dwelling-house, but should strike out at once away from it. Thus, in closetted towns, the drains for the reception of sewage, properly so-called, would have to pass, not along the street, but along the gardens or yards at the backs of the houses.

*Sanitas Sanitatum, et Omnia Sanitas.* By RICHARD METCALFE, F.S.S. Vol. I. London: The Co-operative Printing Company.

THIS work contains much that is interesting and even valuable, much that is doubtful, and much that we cannot even take into consideration without wandering into regions where we might very probably figure to as little advantage as do our political contemporaries when they venture to discuss scientific topics. The author gives us his views on public baths and wash-houses, on the Turkish bath, on the recipients of medical charity, on small-pox, and on "dipsomania." We may remark that in treating of small-pox he strongly questions the value of vaccination. His argument is in substance this:—Every form of pestilence has periods of unusual intensity; and, again, intervals where it becomes rare, or even seems to die out altogether. A well-known instance in point is the plague, which, once so common in England, France, and Germany, has been unknown in Western Europe for a century and a half, and has been very rare even in its supposed cradle in South-Western Asia. Latterly, however, this fearful scourge has been reviving, and is taking year by year a wider sweep. Just in like manner, about the first part of the present century, small-pox seemed to die away, a result which was naturally ascribed to vaccination, then recently introduced. Since that time, however, in spite of the greater care taken in vaccination, and of its being made legally compulsory, the disease has become more and more common, and has at times almost assumed the character of a pestilence. This statement, as far as regards

the rarity of small-pox from 1820 to 1840 is, we believe, correct. The author considers that one pre-disposing cause of small-pox is the want of salt. But this cannot surely apply to a country where salt is so cheap as in England. He thinks that vaccination tends to check the increase of population. If this view is correct the political economists will urge the compulsory vaccination of every person at least once a year. But we doubt if facts will bear out this conclusion. In Germany population increases rapidly, and yet a double vaccination—once in infancy and once about the age of puberty—has been legally enforced there since 1835, if not from an earlier date. As to "dipsomania," we fear that if the drunkards are to be confined in palatial asylums at the cost of the ratepayers the remedy will be even more costly than the disease.

*What is Artificial Mineral Water? A Critical Examination of a Supreme Decision of the Royal Prussian Scientific Deputation on Medical Affairs at Berlin.\** By Dr. HERMANN KOLBE. Leipzig: J. A. Barth.

IT appears that according to a law of the German Empire the preparation and sale of "liquid medicinal mixtures for external or internal application, with the exception of artificially-made mineral waters," is limited to the licensed pharmaceutical establishments (*Apotheken*). A manufacturer of mineral waters near Magdeburg, who though a qualified pharmaceutical chemist (*geprüfter Apotheker*) was not the possessor of a registered shop, seems to have prepared not merely imitations of the waters of known mineral springs made up according to their analysis, but also analogous waters, which perhaps are not found flowing from any natural spring. By so doing he was held to have gone beyond the limits of the exception above quoted, and to have incurred a penalty. Prof. Kolbe contests the reasoning of the "scientific deputation," who pronounced that the preparations in question were not "artificial mineral waters," and he certainly seems to us to have the best of the argument. Had we in this country to contend with such minute and all-pervading legislation we should certainly complain of being too much governed.

*Annual Report of the Scientific Club of Vienna.†* 1876 to 1877.

WE have here an account of an establishment which fills us with wonder, not quite unmixed with envy. It offers to its members all the conveniences and attractions of a London Club, and much more, all for an entrance fee of five florins and an annual subscription of sixteen florins, which may be paid quarterly—this, it must be remembered, in a city where the cost of living cannot be pronounced lower than in London. The club, though only founded last year, numbers 640 members, and appears to be in every way flourishing. Among the objects of the club, in addition to its general purpose of serving as a medium for closer and more amicable intercourse among scientific characters and men of high culture, may be mentioned lectures, discussions and *conversazioni*, scientific excursions, assistance to scientific explorers by means of advice, letters of introduction, &c., even if material aid cannot be afforded; the friendly reception of foreign men of science, authors, artists, &c, who may pass through Vienna. In short, the club will possess, *en permanence*, many of the most desirable features of a meeting of the British Association during its week of existence. We wish the club prosperity, and imitators at home and abroad.

*Report of the Commissioner of Agriculture for the Year 1875.* Washington: Government Printing Office.

THE report of Mr. W. McMURTIE, Chemist to the Department, is devoted to the influence of caustic magnesia

\* Was ist Künstliches Mineral Wasser? Kritische Belichtung eines Obergutachtens der Königlich-Preussischen wissenschaftlichen Deputation für das Medicinalwesen zu Berlin.

† Jahresbericht des Wissenschaft Club.

upon the vegetation of lime-soils; the proximate composition of two varieties of sugar-corn; the influence of arsenical compounds present in the soil upon vegetation; the influence of coal-gas upon the aerial portion of plants; the percentage of morphia in a sample of opium grown in Tennessee; the chemical composition of the mineral matter of cranberries: the composition of certain cave deposits found in the Southern States; and the percentage of tannin contained in various tanning materials.

Magnesian limes seem to have a peculiarly unfavourable effect upon light, sandy soils, first noticed by Sir H. Davy, and ascribed by him to the slowness of caustic magnesia in becoming neutralised by the carbonic acid of the atmosphere. In clay soils the magnesia forms a double compound with the silicate of alumina, and exerts no injurious action.

The action of arsenical compounds upon vegetation and upon agricultural soils has become an important consideration since "Paris green" has been extensively used for the destruction of the Colorado beetle and other insect pests. The following questions suggest themselves:—If applied to the soil can arsenic or arsenious acid be absorbed and assimilated by plants? If assimilated can it be taken up in quantity sufficient to become prejudicial to consumers? If not taken up by the plant during growth does it by its presence in the soil exert a poisonous action upon the plant? If so to what extent may it exist in the soil before it becomes injurious?

As regards the absorption and assimilation of arsenic Mr. McMurtie's experiments give a negative result. All the plants grown were examined by Marsh's test, and in no case was a trace discovered. Nor do arsenical compounds exert any injurious effect upon vegetation till the quantity present per acre reaches 900 lbs. for Paris green; 400 lbs. for arsenite of potassa; and 150 lbs. for arseniate of potassa.

The effect of coal-gas upon the aerial parts of plants—as distinct from the roots—was found to be destructive to vegetation. Camellias and other plants confined in an atmosphere containing from 1 to 2 per cent of coal-gas were killed.

The report of the Entomologist, Mr. Townend Glover, is also interesting. He has been especially engaged with an investigation into the habits of the *Hemiptera*, some of which are very destructive to vegetation, whilst others, being carnivorous, serve to keep the plant-feeding allies in check. *Dysdercus suturellus* not only sucks the juices of the cotton ball and seed, but depreciates the value of the fibre by voiding upon it an excrementitious yellow fluid of a colour not easily removed. It was once thought that this insect might afford a brilliant red tinctorial matter. Dr. Jackson, of Boston, however, only succeeded in obtaining from it a yellow dye, a pigment which he thought might serve as a basis for certain compound colours, such as greens and browns. But the supply of such dye-wares already far exceeds the demand. Several of the *Hemiptera*, when thrusting their rostrum into any living being, inject a poisonous fluid. The author considers the bite of the wheel-bug (*Reduvius novenarius*) as much more painful than the sting of a large wasp or hornet. In one case the flesh surrounding the puncture was so much poisoned that it sloughed off, "leaving a small hole in the injured thumb."

Reading this interesting memoir, and knowing what an important part for good or evil insects play in the productiveness of any country, we cannot help asking how it is that official entomologists are not carrying on similar investigations, if not in the home kingdoms, yet at any rate in India and in the tropical and semi-tropical colonies. Such an arrangement might easily effect a saving of millions to the empire. Perhaps, however, it is as well that the attempt is not made, as in the present humour of the nation the appointments would not be given to specialists like Thomas Edwards but to plausible sciolists of the "good all-round" type, who could "pass" in the laws and literature of Siam, in the interpretation of Egyptian

hieroglyphics, in Araucanian theology, and in everything else that was utterly foreign to his prospective duties.

*General Index to the New York Medical Journal, April, 1865, to June, 1876.* (23 vols.) By J. B. HUNTER, M.D. New York: Appleton and Co.

A USEFUL and laborious compilation.

*Design and Work: a Home and Shop Companion.* Vol. II. London: G. Purkess.

THE appearance of this journal may doubtless be regarded as proof of an increased interest felt in applied science. Its columns are devoted to illustrated articles on elementary carpentry and joinery, the making and use of lathes, photography, telegraphy, metallurgy, technical chemistry, &c. There is a very extensive "Notes and Queries" department, a "Sale and Exchange" column, and an amount of correspondence which will certainly give the editor little time for dozing in his official chair. The information supplied to the readers of the paper, as far as we have had the opportunity of judging, is mainly correct and useful. Here and there an oversight slips in. Thus, in testing for nitrates in solution with protosulphate of iron and sulphuric acid, it is stated that if nitric acid is present a *green* cloud will be formed round the fragment of copperas thrown in. The colouration produced will be not green but of a reddish brown. The subject matter of the journal is not, however, by any means limited to technology, since we find notices of two theological works, papers on the future of the Drama, the women of Ancient Athens, the City Companies, &c. We notice that several correspondents complain of unfairness in the management of the late Centennial Exhibition at Philadelphia. If we may suggest we should certainly say that the insertion of "paragraph advertisements" of proprietary medicines scarcely suits the dignity of a scientific journal. Upon the whole we may wish *Design and Work* success, as calculated to let in the light of science in quarters hitherto but scantily illuminated.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 5, July 30, 1877.

Consequences deduced from Experiments made on the Action of the Gaseous Products of Dynamite with reference to Meteorites, and to various circumstances of their Arrival in the Atmosphere.—M. Daubrée.—The author compares the effects produced upon zinc and iron by the gases generated on the explosion of dynamite with certain peculiarities of meteorites, and traces a very close similarity.

Observations on Chemical Equivalents compared with Corpuscular Elements.—M. A. Baudrimont.—The author holds that if the chemical elements belong to a positive part of the science they are insufficient to characterise its progress, for being invariable they cannot represent all the ponderable modifications which bodies may undergo. If molecules escape from direct observation, their existence is nevertheless revealed to us by a totality of properties of the highest order. They are in harmony with chemical proportions, with the laws of Gay-Lussac and Avogadro, of Dulong and Petit, of Neumann, and those which the author has formulated, and, moreover, with isomorphism, polymorphism, allotropy, and all the fundamental properties of bodies.

**Separation of Iron from Chrome and Uranium.**—M. A. Ditte.—The separation of these metals presents certain difficulties. If we treat the substance under examination with oxidising agents, so as to make the chrome pass into the state of an alkaline chromate, either in order to determine the chromic acid as mercurous chromate, or with a view to reduce the chromate with hydrochloric acid and alcohol, precipitating the sesquioxide of chrome afterwards by means of ammonia, we necessarily introduce alkalis which it is difficult to get rid of, and whose presence may be inconvenient in the course of the analysis. As for the method of separating chromic oxide, by means of its solubility in cold potassa, it must be regarded as giving results scarcely even approximate. In like manner the separation of uranium by carbonate of ammonia, which ought to dissolve it entirely as uranate of ammonia, is not easily completed. We succeed better if, after having precipitated the oxides by ammonia, and having calcined them in a current of hydrogen, we treat the residue with dilute hydrochloric acid. The iron may be thus removed, but the protoxide of uranium is not perfectly insoluble in this acid unless it has been very strongly ignited. It is then washed, dried, and re-ignited in a current of hydrogen before weighing. The separation of these oxides may be effected with great accuracy by operating in the manner proposed by M. Sainte-Claire Deville for the separation of iron and alumina. The metals are brought to the state of sesqui-salts; all metals whose sulphides are insoluble in dilute acids are removed by known methods, and the ferric, chromic, and uranic oxides are then precipitated together by an excess of ammonia. Care must be taken to drive off by ebullition any free ammonia which might dissolve a portion of the latter. The oxides are well washed, calcined, placed in a porcelain tube, and heated to redness in a current of pure hydrogen. The ferric oxide becomes metallic iron, the uranic oxide (a mixture of  $U_3O_4$  and  $U_4O_5$ ) is reduced to  $UO$ , while the chromic oxide remains unaltered. This mixture of iron, uranium protoxide, and chromium sesquioxide is weighed, returned to the tube, and submitted to the action of a current of gaseous hydrochloric acid at a red heat. The oxides of uranium and chrome remain entirely unattacked by the acid, and their weight suffers no variation. As for the iron, it is entirely volatilised as ferrous chloride, and deposited in white crystals in a cooler part of the tube. After an hour or an hour and a half the boat is allowed to cool in a current of hydrogen intended to drive out the hydrochloric acid from the tube, and the mixture of chromic oxide and uranic oxide is weighed, and treated with pure nitric acid. The protoxide of uranium which remains in the form of a brown amorphous powder is at once attacked, even in the cold, with evolution of nitrous fumes and formation of uranium nitrate. It is well, however, to heat for a few moments in order to be certain that the chromic oxide retains no traces of uranium; the solution is then filtered off, and the residue calcined and weighed.

**Certain Properties of the Sulphides of Platinum considered from an Analytical Point of View.**—M. J. Ribau.—Platinic sulphide, prepared either in the cold or at the temperature of the water-bath, and taken alone—or at any rate in the absence of the metals of the first two groups—may be considered insoluble in the ammoniacal sulphides and the alkaline mono- and polysulphides. It may be placed in the second group along with mercury. Considerable quantities of platinic sulphide may be dissolved by means of well known artifices, such as pouring a solution of platinic chloride drop by drop into a sulphide, or melting a mixture of platinic sulphide and dry alkaline sulphides at redness. Platinic sulphide may be dissolved in ammoniacal sulphides and alkaline polysulphides in presence of metals of the first group, and in quantities the greater the more such metals are present. Platinic sulphide mixed with all the metals of the second group is not dissolved by ammonium monosulphide, but by the trisulphide, though less than copper. Platinous sulphide, according to its physical condition and the nature or degree of sulphurisa-

tion of the solvent, may be considered as either almost insoluble or as soluble. But the platinous salts are rarely met with in analysis, and can be readily converted into platinic compounds. The presence of platinum in the first group, to which it does not seem to belong, seems due to the common phenomena of entanglement. From the point of view of practical analysis, platinum should be sought for in the first group, and especially in the second, where it may be found entirely or in great part along with mercury. The detection of the metal in the first group has been already pointed out by authors: to find it in the second the sulphides of the second group must be treated with boiling nitric acid diluted at most with an equal volume of water. Sulphides of mercury and platinum remain unattacked; when dry they are introduced into a small sublimation tube. On heating we obtain a volatile ring, sulphide of mercury, and a fixed residue, sulphide of platinum. We separate these two parts by breaking the tube, and dissolve the mercurial ring in *aqua regia*. The fixed residue is roasted a few moments to convert it into metallic platinum, and is then dissolved in *aqua regia*.

**New Method of Transforming Camphor into Camphen.**—M. J. de Montgolfier.—The camphor after fusion is treated with sodium at a gentle heat.

**Note on Certain Compounds of Titanium.**—E. Wehrlin and E. Girard.—Not suitable for abstraction.

**Determination of Potassa.**—M. A. Carnot.—Reserved for insertion in full.

No. 6, August 6, 1877.

**Experimental Researches with the Gases Produced by the Explosion of Dynamite on various Characteristics of Meteorites (continuation).**—M. Daubreé.—The compression of the air which the meteorite drives before it produces not merely the heat, the incandescence, and the luminous train observed in such bodies. This compression contributes principally to the rupture of the mass, however tenacious, to the superficial tarnish of each fragment, and to the partial pulverisation of the substance.

**Reply to some of the Objections advanced by M. Cosson against the Project of the Formation of a Saharian Sea.**—M. Rouddaire.—An account of the beds of certain ancient rivers in the Sahara.

**Comparative Influence of Leafy Trees and of Conifers upon the Rainfall and the Hygrometric Condition of the Air.**—M. Fautrat.—The author shows that conifers, such as the various pines and firs, have a much greater influence than trees with true leaves. Hence he recommends the formation of pine-woods in Algeria.

**On the Catechins.**—Arm. Gautier.—A number of substances, having among themselves differences and analogies of the same order as the tannins which accompany them, have hitherto been confounded under the name of catechin. He distinguishes catechin from the yellow catechu of Bengal,  $C_{21}H_{18}O_8$ ; catechin from a brown catechu of Pegu, agreeing in formula with the foregoing, but fusible at a temperature lower by  $50^\circ$ , and catechin from mahogany,  $C_{42}H_{34}O_{16}$ .

**Experiments Proving that Chloroform has no Action either upon the Septicity or the Vibriones in Putrid Blood.**—M. V. Feltz.—Chloroform mixed with putrid septic blood in the form of vapour, or added directly to this liquid, has no appreciable effect either on its vibriones nor on its septicity.

*Biedermann's Central-Blatt für Agrikultur Chemie,*  
Heft 4, April, 1877.

**Carbonic Acid in "Ground Air."**—Dr. Port.—Determinations of carbonic acid in the ground-air were made at Munich at depths of 1.5 to 3.0 metres. It appears that the greatest amount of carbonic acid was generally observed in the autumn. In most of the stations the proportion of carbonic acid was greater in 1873 than in 1874.

In some stations there was more carbonic acid found at the depth of 1.5 than at that of 3 metres, but in most instances the proportion was reversed. The proportion of carbonic acid in the ground-air gives a useful measure of the degree of pollution of the soil.

**Condensation of Water in Arable Soils.**—Prof. Adolph Mayer.—The author concludes that the condensing power of arable soils is of no importance for the nutrition of plants. On the contrary, the greater this condensing power is the less water does a soil place at the disposal of crops.

**A Manurial Experiment with Beet-root.**—M. Heidecke.—Not suitable for abstraction.

**Researches on the Consumption of Oxygen and the Excretion of Carbonic Acid in Man.**—Dr. Speck.—The author has examined the changes produced in the respiratory process by the use of fatty food, of coffee, quinine, alcohol, and water, and by the inspiration of air respectively rich in carbonic acid, poor in oxygen, and rich in oxygen. His chief conclusions are—(1) With an increased proportion of hydrogen in diet the amount of the air inspired and expired decreases. Nutriments, such as sugar, which contain little hydrogen in comparison with their oxygen, involve more exertion of the respiratory organs than such as are rich in hydrogen, like the fats. (2) The more carbon predominates in the food in proportion to hydrogen the more air is exhaled in proportion to that inhaled. (3) The more carbon increases in the diet in proportion to hydrogen, the more carbonic acid is evolved and the more oxygen taken up; the richer the diet in hydrogen the less oxygen is required. An atmosphere containing 5 or 6 per cent of carbonic acid could be breathed for some minutes without oppression. At 11.51 per cent great exertion was needful to breathe for one minute. At 7.2 per cent all the carbonic acid produced in the body is retained in the blood, and at 11.2 per cent a great part of that also which is inhaled.

**The Origin and the Deposition of Glycogen in the Animal Organism.**—Dr. S. Wolffberg and Dr. von Mering.

**Locality of the Deposition of Fat in Animals under Different Diets.**—Dr. G. Foster.—Not adapted for abstraction.

**Decrease of Lime in the Body, and especially in the Bones, with Deficient Ingestion of Lime.**—Dr. J. Foster.—If in a diet, ample as regards the constituents of the albuminoids, lime is insufficient, the muscles and also the skeleton show a deficiency in this earth.

**Influence of Frost upon Cabbages.**—Dr. Pagel and Prof. Märcker.—The action of frost occasions the formation of a considerable amount of sugar.

**Evolution of Oxygen from Parts of Plants in the Absence of Carbonic Acid.**—Prof. A. Mayer and Dr. H. de Fries.—A controversial paper of little importance.

**Behaviour of the Saccharine Juice of Cells with Alcohol and Glycerin, and the Distribution of Sugar.**—Prof. G. Kraus.—Not adapted for abstraction.

**Detection of Certain Organic Compounds in Vegetable Tissues.**—Dr. Ottomar Herrmann.—For the micro-chemical detection of datiscin the author recommends the application of lime- or baryta-water, which gives an intense yellow colour to the cells containing the glucoside. On the addition of acetic acid or dilute hydrochloric acid this colour at once disappears. In order to detect berberin we may use nitric acid. On merely examining plants containing this alkaloid we find in certain parts cells filled with a gold-yellow liquid or intense yellow membranes. On the addition of alcohol and very dilute nitric acid this colour disappears in a short time, and numerous gold-coloured crystals are formed, which chiefly occupy the interior of the cells in stellar groups. Sulphide of ammonium occasions a brown colouration. Colchicin takes an intense yellow colouration in contact with

alkalies. To detect phloridzin we may utilise its deep brown-red solution in ferric chloride, and its brown-yellow precipitate with ferrous sulphate. The presence of a small quantity of tannic acid renders the colour deeper, but does not effectually mask the reaction. Larger quantities of tannin interfere. Curcumin is dissolved by mineral acids with a carmine-red colour, but not without decomposition. Its solutions give red-brown precipitates with the salts of lime and barium, and firey-red precipitates with the salts of lead. Nucin may be recognised by the purple-red colour which it assumes with alkalies, preferably with the fumes of ammonia. The colour is not permanent, and soon passes into various shades of brown. The author detects rutin by the intense yellow solutions which it forms with carbonated and caustic alkalies, lime- and baryta-water, and which on exposure to the air take up oxygen and turn brown. Plumbagin dissolves in alkalies with a red colour, which passes into yellow on the addition of an acid. Chrysophanic acid is recognised by the splendid purple-red colour with which it dissolves in aqueous alkalies. Frangulin takes a carmine-red with dilute potassa.

**New Method for the Quantitative Determination of Crude Fibre.**—Dr. Hugo Müller.—Already noticed.

**Selection of Seed for Beets.**—Dr. Jos. Hanamann.

**Kinds of Potatoes Most Suitable for Cultivation on the Large Scale.**—Eugène Marie.

**Practical Studies on the Cultivation of Flax.**—Gaetan Cantoni.—These papers refer more to practical husbandry than to the chemistry or physiology of plant-life.

**Frozen Beets.**—E. Barbet.—The author finds that frost converts sucrose into glucose.

**Application of Tribasic Phosphoric Acid for Purifying Saccharine Juices.**—A. Galwalowski.—The application of phosphoric acid seems to promote the removal of albuminoid matters.

**Substitute for "Separate Saturation."**—M. Maumené.—Technical details of the process of manufacturing beet-root sugar.

**Gelatinous Deposits from Beet-root Juices.**—Feltz, Jubert, and Kohlrausch.—An abstract of the views of the chemists mentioned.

**Specific Rotation of Glucose.**—Prof. Tollens.—From the *Berichte der Deutschen Chemischen zu Berlin*.

**Conversion of Cane-Sugar into Reductive Sugar during Refining.**—Aimé Girard.—From the *Comptes Rendus*, 1876, vol. 83, p. 196.

**Researches in Brewing.**—C. Lintner and Krandauer.—Incapable of abstraction, consisting chiefly of tables.

**Transformation-products of Starch.**—Cornelius O'Sullivan.—See CHEMICAL NEWS, vol. xxxiii., p. 218.

**Analysis of Alsatian Wines.**—Dr. Curt Weigelt.—A notice of certain Alsatian wines not known in commerce.

**How to Avoid the Blackening of Wines.**—Dr. P. Wagner.—The author recommends that no article of iron, such as nails, screws, &c., should be allowed to come in contact with the wine.

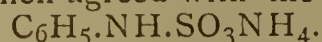
**Dr. H. Soxhlet's Process for Making Butter.**—E. Egan.—The author finds that this process, which consists substantially in freezing the cream before churning, produces butter in less time than the ordinary process. There is, however, a loss in quantity.

*Archives Néerlandaises des Sciences Exactes et Naturelles*,  
Tome x, 4me livraison.

**Certain Substances derived from Uric Acid, or having relation with it.**—E. Mulder.—The compounds described in this long and important paper are hydantoin, triglycolamide-triuramide, silver-cyanamide, carbo-di-imide, silver-urea, hydrous parabanic acid, dialurate of

urea, alluronic acid, with an account of its transformation into alloxanic acid, mycomelic acid, uranoxanic acid, and oxonic acid. The pre-existence of alloxane in the animal organism is also discussed.

Reaction of Sulphite of Ammonia upon Nitrobenzol—J. A. Roorda Smit.—After reviewing the previous experiments of Piria, Laurent, Hillenkamp, and Carius, the author describes the compound which he obtained, the composition of which agreed with the formula—



Preparation of Acetate of Ammonia and of Acetamide.—J. Roorda Smit.—The author introduces glacial acetic acid into a spacious flask, and neutralises with carbonate of ammonia. In preparing acetamide he collects all the products which distil over below  $200^\circ$ , and neutralises with carbonate of ammonia.

Tome xi., 1ere Livraison.

Composition and Constitution of Plumieric Acid.—A. C. Oudemans, jun.—The author reduces the three plumieric acids of M. Altheer ( $\alpha$ ,  $\beta$ , and  $\gamma$ ) to one,  $\text{C}_{10}\text{H}_{10}\text{O}_5$ . By submitting this to the action of sodium-amalgam he obtains dihydro-plumieric acid,  $\text{C}_{10}\text{H}_{12}\text{O}_5$ .

On the Liquid Xylenol obtained by means of Metaxylol (Isoxylol).—S. Lako.—The author's xylene is identical with that of Wurtz.

Tome xi., 2me Livraison.

This issue contains no chemical matter.

*Journal d'Hygiène,*  
Nos. 47, 48, 49, 50, 1877.

These issues contain no original chemical or physical matter.

## MISCELLANEOUS.

University of London.—The following is a list of candidates who have passed the First B.Sc Examination:—*First Division.* Alfred Hodgetts Atkins, private study; Herbert Irving Bell, private study; Charles Frederick Cross, King's and Owens Colleges; Samuel Dixon, Owens College and private study; Henry Edmonds, private study; Lewis Humfrey Edmunds, University College; Walter Fowler, Caius College, Cambridge; Ernest Compton Gill, private study; Wintour Frederick Gwinell, Royal School of Mines; Edward Harlock, Owens College; Hugh Erat Harrison, University College; William Havelock Hill, University College; William Heaton Horrocks, Owens College; Moses John Jackson, University College; Alfred John King, Owens College; Frederick Herbert Lane, Epsom College; Joseph Larmor, St. John's College, Cambridge; Hyde Marriott, Owens College; Sidney Harris Cox Martin, University College; Samuel Sheppard Oakley Morris, private study; Thomas Jeffery Parker, Royal School of Mines; Herbert Pearce, University College; George Henry Spencer Pearson, private study; Richard Charles Rowe, M.A., Trinity College, Cambridge; Frederick Wallis Stoddart, University College, Bristol; Duncan Taylor, private study; William Henry Thomas, Royal College of Chemistry; Daniel Walker, Owens College and private study; Malcolm Webb, Owens College. *Second Division.* Isaac Blore, The Leys, Cambridge; Pramatha Nath Bose, University College; Edwin Drew, private study; Sidney John Hickson, University College; Henry Robert Hind, private study; Isaac Patchett, private study; Arthur Lee Sparkes, private tuition; Peter Thom, University of Aberdeen.

## COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

JULY, 1877.

THE following are the returns of the Society of Medical Officers of Health:—

		Appearance in 2 foot Tube.	Ammonia.		Nitrogen as Ni- trates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	An- Sulphuric hydride.	Hardness on Clark's Scale	
			Saline.	Organic.								Before Boiling.	After Boiling.
			Grs.	Grs.								Grs.	Grs.
<i>Thames Water Companies.</i>													
Grand Junction	.. ..	Slightly turbid	0'001	0'007	0'120	0'052	17'00	7'390	0'430	0'94	1'200	11'0	2'8
West Middlesex	.. ..	Slightly turbid	0'000	0'007	0'105	0'053	17'10	7'280	0'210	0'94	1'330	11'8	3'3
Southwark and Vauxhall		Slightly turbid	0'001	0'008	0'090	0'050	20'70	7'950	0'360	0'87	1'260	12'1	2'8
Chelsea	.. ..	Slightly turbid	0'000	0'007	0'090	0'057	17'40	7'440	0'320	0'87	1'200	12'1	2'4
Lambeth	.. ..	Slightly turbid	0'000	0'009	0'120	0'052	17'00	7'160	0'280	0'94	1'460	11'8	3'3
<i>Other Companies.</i>													
Kent	.. ..	Clear	0'000	0'003	0'300	0'015	26'70	9'350	0'820	1'30	2'200	17'0	5'1
New River	.. ..	Clear	0'000	0'006	0'120	0'019	16'40	7'670	0'430	0'94	0'860	12'1	3'3
East London	.. ..	Clear	0'000	0'007	0'090	0'046	18'30	7'780	0'210	1'01	1'260	12'1	3'3

The quantities of the several constituents are stated in grains, and calculated in 70,000 grains of water or 1 imp. gall.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY.

### OWENS COLLEGE, MANCHESTER.—

The NEXT SESSION WILL COMMENCE—In the Arts, Science, and Law Department, on the 2nd October; in the Medical Department on the 1st of October; and in the Evening Classes on the 15th October.

Candidates for admission must not be under 14 years of age, and in the Arts and Science Department those under 16 will be required to pass a Preliminary Examination in English, Arithmetic, and Elementary Latin.

Prospectuses of the several Departments may be obtained from Mr. Cornish and other Booksellers in Manchester, and at the College.

J. HOLME NICHOLSON, Registrar.

### St. Mary's Hospital Medical School, PADDINGTON, W.—ENTRANCE SCHOLARSHIPS.—

Two Scholarships in Natural Science, tenable for three years, one of the value of £60 the first year, £40 the second, and £20 the third year; and one of the value of £60 the first year, £25 the second, and £15 the third; also, an Exhibition, of the value of £20, tenable for one year—will be open for competition on Tuesday, October 2nd, 1877, and following days.

The Subjects of Examination are Inorganic Chemistry, Natural Philosophy, Mechanical Philosophy, Botany, and Zoology.

For further particulars and conditions apply to the Dean,

A. B. SHEPHERD, M.D.

# THE CHEMICAL NEWS.

VOL. XXXVI. No. 928.

## ON A NEW UNIT OF LIGHT FOR PHOTOMETRY.\*

By A. VERNON HARCOURT, F.R.S., &c.,  
One of the Metropolitan Gas Referees.

IF we compare the corresponding operations of photometry and calorimetry, we have for the latter an unexceptionable scientific unit in the quantity of heat that will raise the temperature of a weight of water from the point of freezing, or of maximum density, through one degree. We have also a serviceable practical unit, for the comparison of various fuels, in the quantity of heat that will evaporate a pound of water. But for photometry there is no accepted scientific unit, nor even any sufficiently good practical unit for comparing different modes of illumination, or fixing the bargain made between gas companies and the public.

The unit which is actually employed for expressing and estimating the illuminating power of coal-gas is defined by Act of Parliament to be "a sperm candle of six to the pound, consuming 120 grs. of sperm per hour." One advantage the adoption of a candle as a unit has. It is generally intelligible. Every one has an impression of the amount of light which a candle gives; and the statement that a particular lamp gives the light of 10 candles conveys a tolerably good notion of the illuminating value of the lamp. This advantage, however, is by no means bound up with the use of candles in the operation of photometry. The name of candle might well be retained for a unit of light similar to the light of one candle, as "foot" and "grain" are employed for exact measures of length and weight, although the actual value of the unit were defined without reference to any particular kind of candle.

All who have used candles for photometry are familiar with the fluctuations and uncertainty to which their mode of burning and their varying character lead. It is only by a free use of averages that an approximately trustworthy result can be attained. Some well-devised experiments were made seven or eight years ago by Messrs. Kirkham and Sugg, with an apparatus called by them a cross-photometer, in which a single gas-flame was the central point of four candle photometers arranged crosswise, so that observations of its illuminating power might be made simultaneously by four observers. The differences in the results, after applying the usual proportional correction, where more or less sperm was consumed than the standard quantity, amounted frequently to two or three candles in the estimated value of a gas-flame of an average value of 14 candles. These experimental observations illustrate in a striking manner the uncertainty which attends the existing system of photometry; but the divergency includes the effect of other causes besides the difference between different pairs of candles, such as instrumental errors and the personal equation of the observers.

Where all precautions are taken, such as lighting the two candles, which are used simultaneously, at opposite ends, so that, their form being slightly conical, one may burn down towards the thicker, and the other towards the thinner end; when the candles are lit for some time before they are used; and when several successive observations are made, each with a different pair of candles, I find that the variations in the estimation of the same

sample of coal-gas rarely exceed about half a candle, or 3 per cent. Occasionally, however, greater differences occur, and the average results of single sets of observations frequently vary by more than one candle, in the estimated illuminating power, even when the same pair of candles is used.

The source of these variations lies partly in external conditions; partly in the composition, and partly in the construction of the wick, of the candles. Atmospheric pressure and temperature affect the amount of light which a candle gives. Dr. Frankland has shown that a diminution of pressure promotes perfect combustion, corresponding to an increased supply of air, and *vice versa*; so that at pressures less than the ordinary atmospheric pressure a smoky flame becomes clear, while under an increased pressure alcohol burns with a luminous flame. Thus the effect of changes of pressure may be compensated or may be exaggerated in the photometric estimation of coal-gas by the effect produced simultaneously, under different conditions or states of burning, upon the candle and the gas. When a candle-flame is long and smoking at the top, a slight decrease in atmospheric pressure would, no doubt, add to its illuminating power; when the combustion of the vapourised grease is perfect, diminished pressure would diminish the light. It has been pointed out by Dr. Heisch that with an Argand burner two different qualities of gas, burning at the same rate, may give the same amount of light—a poorer gas which the burner supplies with the quantity of air suitable for the full development of its illuminating power, and a richer gas which is burnt at a disadvantage, the supply of air being insufficient for its needs. In the first case, a small decrease in the atmospheric pressure would diminish, in the second it would increase, the quantity of light.

Differences in the temperature of the air affect the flame of a candle, by altering the distance between the bottom of the flame and the upper surface of the grease, or by keeping the cup of the candle more constantly filled with melted grease. In hotter weather a candle of a material with a comparatively high melting-point, such as spermaceti, which melts at a temperature varying from 109° F. to 112° F., according as it is prepared in winter or in summer, gives rather more light than in colder weather. The value of the same sample of gas tested with the same pair of candles appeared to be 18.2 candles at the temperature of the room, but only 16.9 candles when the temperature of the end of the photometer in which the candles were placed was raised artificially by about 20° F.

To give sperm candles a homogeneous appearance, the spermaceti is mixed with a small quantity of wax, the proportion of which is slightly varied. I am not aware whether this has any appreciable effect upon the illuminating power.

The sperm candles which are used for testing gas differ from those supplied to the public. They consume sperm less rapidly, and give less light.

The regulation of the rate of consumption is effected by varying the number of threads in the strands which form the wick. One of the principal makers of the candles used for gas-testing is now experimenting upon the effect of altering the strain upon the wick when it is fixed in the mould. A change in this respect may probably alter the curvature of the wick within the flame, and thus, perhaps, improve the light given by the candle.

A few years ago the nominal quality of the coal-gas supplied to the Metropolis was changed to the extent of nearly two candles by the adoption of a greatly improved burner in the photometer. It seems possible that if similar care and ingenuity are bestowed in perfecting sperm candles, within the parliamentary definition, which leaves not only the wick but also the diameter of the candle to the discretion of the makers, an improvement of 10 to 12 per cent may be effected, which would make the requirement of a higher illuminating power a reality.

Clearly, however, what is to be desired is, neither that the gas companies should gain an advantage by an im-

\* A paper read before the Physical and Chemical Sections of the British Association at Plymouth.

provement in the test burner, nor that the representatives of the gas consumers should gain an advantage by the introduction of an improved standard candle, but that the system of photometry should be fixed upon such a basis that a contest of this kind would become impossible. A step in this direction was taken last year by the definition of the burner to be employed in testing. One of the Argand burners used in one of the official testing-places—of which there are now twelve in different parts of London, at each of which three testings are made daily of the illuminating power of the gas supplied—was measured and figured; and verified copies of this burner, which is to be exactly imitated for the future, were deposited with the Warden of the Standards, and with the Companies, and with the City and Metropolitan Board. But what is still needed is that equal definiteness should be secured for the unit of light or standard measure, which is employed to determine the amount of light which is yielded by a given sample of gas when burning as the rate of 5 cubic feet an hour at the standard burner.

Time will not permit me to do more than mention the methods which have been tried or have been suggested for this purpose. In Paris, the light with which the gas-flame is compared is a lamp consuming colza oil at the rate of 42 grms. an hour. Mr. Keates has proposed the adoption in this country of a similar lamp burning sperm oil. The light of the lamp is said to be more constant than that of candles, and the operator has the advantage of being able himself to adjust the rate of consumption. But the main difficulty in the way of definition and constancy in the case of candles—namely, the variable structure and varying condition of the wick—reappears in the case of lamps, though probably the variations are less in amount, owing to the power which exists of adjusting the wick and the greater simplicity of its form during combustion.

An ingenious kind of lamp was made some years ago by Mr. Crookes, in which the two *desiderata* of known composition of fuel and definition of the wick were secured by using for the fuel a mixture, in definite proportions, of benzene and alcohol, and for the wick a bundle of platinum wires of a particular size. Unfortunately, the light given by this lamp is only a fraction of the light of a candle, and thus it cannot be used for comparison with so bright a flame as that of gas burning at any ordinary gas-burner.

Other modes of photometry which have been tried or proposed I must, on this occasion, pass by, with the remark that since the value of an illuminant depends solely upon such parts of the total force radiating from a flame as affect the human eye, no test of illuminating power can be satisfactory which does not depend upon vision; at least, until it has been proved that some other effect of radiation, such as the impulse given to the radiometer, or the increase of the electric conductivity of selenium, is for all flames in direct proportion to the effect upon the optic nerve—a relation which seems very improbable, and which cannot be established until some exact mode of measuring the visual effect has first been found.

Three conditions need to be fulfilled for the production of a standard flame. First, the combustible must be of known and definite composition. Secondly, the conditions of burning must be of a simple and definable character. Thirdly, the nature of the combustible and of the conditions of burning must be such that atmospheric changes may produce a minimum of effect upon the light. A fourth condition might be added as highly desirable—namely, that the operator should be able to verify for himself the composition of the combustible he employs. No chemist, at least, would willingly spend time upon a quantitative operation for the accuracy and significance of which he was dependent upon the care exercised by the workmen of the best maker of candles or refiner of oil.

For reasons of another kind, it is desirable that a new unit of light should be made to correspond to the average

value of the existing unit, the light given by a sperm candle consuming 120 grs. of sperm per hour. No change in the nomenclature of photometry would thus be required; the unit of light might still be called a candle, and gas which is described as 14-candle gas or 16-candle gas would retain its appellation, yielding, when burnt under standard conditions, the light of 14 or 16 of the new units.

After trying many different plans, an account of which would carry me far beyond the reasonable limits of this communication, I venture to think I have devised a method which satisfies fairly the conditions I have named. For the standard combustible I employ a mixture of air with that portion of American petroleum which, after repeated rectifications, distils at a temperature not exceeding 50° C. This liquid consists almost entirely of pentane, the fifth member of the series of paraffins. I have made three or four analyses of the liquid, which, though they scarcely distinguish between pentane and the adjoining hydrocarbons of the same series—the proportion of carbon to hydrogen being in pentane

Carbon .. 83.3	and in hexane	Carbon .. 83.7
Hydrogen.. 16.7		Hydrogen.. 16.3

—would reveal the presence of small quantities of hydrocarbons richer in carbon. I have also determined the vapour-density of the liquid. The density of gaseous pentane, compared with hydrogen, is 36; that of hexane 43. I find the vapour-density of the liquid, distilled twice below 50°, to be 37. The lighter portions of purified American petroleum have been carefully examined by Ronalds, Cahours, Warren, Schorlemmer, and other chemists, and have been found to consist of the following hydrocarbons:—Tetrane boiling between 0° and 4°, and having a specific gravity at 0° of 0.6; two isomeric pentanes, one boiling at 30°, the other at 37°, and having at 17° a specific gravity 0.626 (Schorlemmer), 0.628 (Cahours), the proportion of which appears to vary, since the hydrocarbon separated by Cahours boiled at 30°, while Schorlemmer states that the pentane in the sample examined by him consisted almost wholly of the variety boiling between 37° and 39°; hexane, which boils at 68° C., and has a specific gravity at 16° C. of 0.669. The liquid I use has a specific gravity which has only varied in different samples between 0.6298 and 0.63, except in one case, in which, probably owing to the temperature of distillation having been allowed to rise too high, it was 0.631. A sample distilled twice at 40° had the specific gravity 0.6276. It would not be difficult, by rectifying at 40°, to obtain almost absolutely pure pentane. But I do not think it necessary to limit the distillation to this temperature, because the yield at 50° is rather larger, and it seems hardly possible that the admixture of a small and nearly constant proportion of a substance so little different as hexane can affect the quality of the liquid as a combustible. Also I find, having distilled ten or twelve samples of the liquid, using about three litres each time, that I get a constant specific gravity.

To prepare the gas, I draw into the gasholder the required volume of air, chosen according to the capacity of the holder, and corrected for pressure, temperature, and tension of aqueous vapour. The volume may be measured either by means of a meter, or by a scale upon the gasholder. Then the corresponding proportion of pentane is poured into the gasholder from a measuring-flask, connected by means of glass and caoutchouc tubing with a tap in the upper plate. If the liquid pentane comes in contact with the plug of the tap, it acts on the grease which is used to lubricate the plug, and is liable thus to cause leakage. Contact is easily prevented by placing in the mouth of the tap a piece of caoutchouc holding a glass tube, which can slide, air-tight, up or down. The upper end of this glass tube is connected with the flask charged with pentane; the tap is opened, and the glass tube pushed down through the opening. When the contents of the flask have been poured through, and a minute or two allowed for drainage, the glass tube is drawn up until the

tap can be closed, and then the flask and connecting-tubes are removed. The proportion which I propose to maintain between the air and the pentane is 600 volumes of air to 1 volume of pentane, measuring the liquid at or near 60° F.; or, measuring both as gases, 20 of air to 7 of pentane, the vapour-density of pentane being such that it occupies as gas, under the normal conditions of 60° F. and 30 inches barometric pressure less the tension of aqueous vapour at 60°, 210 times the volume which it occupies as a liquid.

When the pentane is poured upon the water in the gas-holder with thrice its vapour-volume of air above, it volatilises rapidly and completely. A few minutes are sufficient for the volatilisation of the liquid, and a few hours suffice for perfect diffusion. It is clearly essential to the uniformity of the air-gas thus made that the liquid should be free from any admixture with non-volatile hydrocarbons, which would accumulate on the surface of the water, and dissolve or give up portions of the gaseous hydrocarbons, but the fulfilment of this condition is ensured by the repeated rectifications which are necessary to separate pentane from the hydrocarbons of higher boiling-point. It is also essential that this vapour or gas should be so slightly soluble in water that the proportion in the air-gas standing over the large volume of water in the tank of the gas-holder may not be appreciably affected by changes in the temperature of the water. Fortunately the gaseous paraffins are most sparingly soluble in water. I have enclosed the vapour of pentane at the tension of 261 millimetres over boiled-out water in an eudiometer for twenty-four hours, and 100 volumes of water dissolved only 0.92 volume of the gas. No doubt the first sample of gas made in the gas-holder filled with fresh water would suffer—and I find that it does suffer—some diminution in the proportion of pentane; but the error, if standard gas is kept in store for photometry, fresh portions being made from time to time over the same water, would only be such as could arise from the difference between the solubility of gaseous pentane, under a pressure of a quarter of an atmosphere, at one temperature and at another; and this error, though real, is likely to be infinitesimal. Many, and, as far as I know, all other substances, which otherwise might be used as the luminous ingredients of a standard gas, such as olefiant gas, or ether, or benzene, are excluded by the necessity of storing and measuring gas over water, and the comparative solubility of these substances in water.

The tension of the vapour of pentane at 17.4° C. is 417 m.m. Mixed with 1½ volume of air, it forms a perfect gas at a temperature of 16.8° C., and under pressures rising at least to 470 m.m. A portion of standard gas transferred from the gasholder to an eudiometer, and measured at various temperatures and pressures, gave the following results:—

Conditions.		Corrected Volume.
Temperature.	Pressure.	
21.1° C.	737.4 m.m.	35.7 c.c.
21.3	933.9	35.6
15.0	764.8	35.4
10.0	761.8	35.4
4.0	756.4	35.5
4.0	910.0	34.3

Thus the gas is a perfect gas, suffering no condensation or abnormal contraction until it is exposed to conditions which could never occur in practice—a temperature of 4° C., and at the same time, a pressure of 1½ atmosphere.

A gas of constant composition having been thus prepared, the next problem is to devise a burner of so simple a construction that, with reasonable care on the part of the maker, there is no likelihood that out of a number of burners made on the same pattern there should be any difference between one and another capable of affecting the amount of illuminating power developed from the same sample of gas. For this purpose there must be no small measurements. I believe brass can be worked so that the error in such a matter as the diameter of a hole

should not exceed 1-1000th of an inch. But where gas is burnt from a small nozzle, even this error may be material. The diameter of the holes in the standard Argand burner is 0.045 inch. A difference of 1-1000th of an inch in the diameter makes here a difference of 5 per cent in the area of the opening. When, as in the burner proposed to be used with the standard gas, the opening has a diameter of a quarter of an inch, its area would be affected by less than 1 per cent by a similar error. The other measurements involved in making this burner are larger, and are less important. The length of the brass tube which the gas enters near its base is 4 inches, its diameter is 1 inch, and the thickness of the disk which forms the mouthpiece is half an inch.

Another condition which the burner needs to fulfil, as far as possible, is that of giving a steady flame. It is not easy to produce a steady flame where gas does not issue under pressure, but flows out at a slow rate through a large hole. Under these conditions a long flame is always unsteady; but by employing a rich gas it is possible to get a cone of flame short enough to be almost as steady as the flame of a candle, and giving the same amount of light. When the gas has burned for a short time the whole length of the brass tube becomes moderately heated, and this contributes to steady the flame; for the gas burns in the axis of a cylinder of ascending air, which, having a definite set, is less swayed by lateral currents. I find that with this burner, either in the box-photometer or in an open photometer, in a room moderately free from draughts, no difficulty occurs through unsteadiness of flame.

I have here a single burner consuming standard gas at the rate of half a cubic foot an hour, and producing a flame whose height from the surface of the burner to the luminous tip, which in still air is almost as fixed and definite as the ivory point marking the level of the mercury in the reservoir of a barometer, is 2 inches and 5-16ths. The height to which the tip of the flame should reach is marked by a piece of platinum wire stretched across. Not only is the height of the flame serviceable as a check upon the preparation of the gas, since only gas which has been made with the due proportion of pentane will give a 2 and 5-16ths inch flame when burning at the rate of half a cubic foot an hour, but the regulation of the height of the flame is more important for the production of a fixed amount of light than the regulation of the rate of consumption.

I have made the experiments, in which I have varied the proportion of pentane to air to the extent of 10 per cent. each way. Such samples of gas give a great excess or defect of light when burnt at the normal rate of half a cubic foot an hour, but very nearly the right amount of light when the rate of consumption is neglected, and the height of the flame is adjusted at 2 and 5-16ths of an inch. I have tried also taking the usual proportion of air to pentane, but using, first, a liquid of rather higher boiling-point—that which distilled between 50° and 55°; and, secondly, the purer sample of pentane, obtained by rectifying twice at 40°. The result in the latter case hardly differed from those obtained with the pentane rectified at 50°; the former mixture gave, at first, a poorer gas, some of the hydrocarbon not having volatilised, and, after the addition of some of the normal mixture of air and pentane, a richer gas. In all cases the light was not far from the standard if the flame was set at the usual height, while the rate of consumption varied considerably.

These experiments show that if, instead of being intentionally varied, the mode of distillation and the proportion of air are kept carefully uniform, the light given by a flame of the standard length will be constant; also that, if the sample of gas has been prepared wrongly, the operator cannot fail to discover the fact by observing that the normal rate of burning does not give the normal height of flame. Any leakage between the meter and the burner would also announce itself in the same way.

What effect the actual barometric variations produce on

the standard flame I have not yet determined, nor is it known in the case of an ordinary gas-flame. It is assumed that a given volume of coal-gas, measured under standard conditions, will yield the same relative amount of light as compared with candles, under any such variations of atmospheric pressure as actually occur. This, as has been pointed out, is an improbable supposition. In comparing together the gas-light and the standard light, it is more likely, since both are gas-flames, that they would be similarly affected by atmospheric variations. This is certainly true of the volume of the two samples of gas; and thus, provided the rates of consumption, as registered by the meters, are 5 cubic feet an hour and 1 cubic foot respectively, no correction need be applied for these variations.

Even if the effect produced upon the light of the standard flame by such atmospheric variations as actually occur should prove to be slight, a definition of the unit must necessarily include a statement as to temperature and pressure. The unit which I propose, and which has been adjusted to correspond to the light of "a sperm candle consuming 120 grains of sperm per hour," is: "The light given by a mixture of 7 volumes of pentane gas with 20 volumes of air, burning from a  $\frac{1}{4}$ -inch orifice at the rate of half a cubic foot per hour, under the standard conditions of 60° F. and 30 inches pressure." For gas photometry it is convenient to use two such units in order to increase the distance between the disk and the standard light.

The question of the advantages or disadvantages of the unit here proposed is distinct from the question of the correspondence between this unit and the average illuminating value of a standard sperm candle. If, as the result of a more extended comparison than I have yet made, the two are found to be not in exact accordance, a slight alteration in the ratio of air to pentane must be made; but the mean result of 30 comparative experiments made with candles and with standard gas prepared in the manner described is:—

	Candles.	Standard Gas.
Illuminating power of gas with "London" Argand, burning 5 cubic feet per hour .. ..	18.0	18.14

The average results are almost identical, but the numbers obtained with candles vary much more one from another than the numbers obtained with standard gas. I have written up as an illustration the results of the last comparative experiment I have made.

	Candles.	Standard Gas.
Value of illuminating gas compared alternately with candles and with standard gas .. .. .	18.0 17.5 18.1	17.6 17.5 17.6

The comparisons were made by setting the gas in an Evans photometer to burn at the rate of 5 cubic feet an hour, and placing alternately in the same position, at the opposite end of the instrument, a pair of sperm candles (applying in this case the usual corrections) and the double standard burner consuming standard gas at the rate of 1 cubic foot an hour.

## PYRO-CHEMICAL ESSAYS.

By Lieut.-Col. W. A. ROSS, late R.A.

FINDING that English chemists and mineralogists are for the most part still unacquainted with the processes developed in my work, "Pyrology, or Fire Chemistry," it is my intention, with the kind permission of the editor of the CHEMICAL NEWS, to publish in that journal the pyrological analyses of minerals from a cabinet purchased by myself in Freiberg. These analyses will be given alphabetically for facility of reference, and are intended to form a supplement to the book "Pyrology" when completed.

The operations are conducted entirely with Fletcher's<sup>s</sup> new hand blowpipe, of which, I believe, illustrated advertisements have already been given in the CHEMICAL NEWS. It consists of, beyond all comparison, the best blower I have ever seen, only one-fifth the price of Lingke's apparatus, and requiring scarcely any exertion of the right hand to keep up an intense blue "flame," but the wooden disk must be rested edgewise on the table, not flat as represented in the picture. By blowing *very* gently a broad blue flame is obtained, either from gas or a pyrological candle, over which may be boiled solutions, &c., in test-tubes or Berlin capsules, better than over a spirit-lamp or Bunsen burner, because when well heated the capsule may be held 3 inches *in front* of the blowpipe, whereby all spirting is avoided. The travelling pyrologist, therefore, need not now take a spirit-lamp or spirits with him at all.

### I. Adularia.

As it happens, this first mineral on the list is one of the most troublesome to analyse in the whole cabinet, on account of the action of the potash which it contains upon the boric acid bead, whereby the formation of combined lime or other borate balls is prevented; but the English student will see by a reference to Prof. Cornwall's admirable American translation how very little Plattner and Richter have been able to determine in *Adularia* by the blowpipe, even with the assistance of hydrochloric acid.

(1.) *Appearance*.—Colourless, transparent, vitreous; crushes easily in (a) forceps; \* hardness less than quartz.

(2.) The fine powder in a bead of boric acid; gave merely a transparent edgeless mass like melting ice, which was proof that an alkaline silicate (probably containing alumina) was there.

(3.) A speck of cobalt oxide added to (2) bead B.B. did not merely form a black ball, but diffused a pink colour, showing that more than 5 and under 20 per cent of alkali was present.

(4.) A fragment of the mineral strongly heated B.B., and held in platinum forceps in the *upper* part of the base of the blue gas "flame" or pyrocone, where the blast passes, afforded a continuous violet colour, showing that the alkali was potash.

### Collection of Evidence.

We have now proof that the mineral is a silicate (for though not unlike transparent quartz it was not hard enough for that) containing free potash, otherwise the "flame" in (4) would have been orange. It was probably, therefore, aluminium silicate containing potash, which always gives an icy mass in boric acid (2), and we saw from (3) and (4) that there was from 5 to 20 per cent of potash in it. Some special treatment, therefore, became necessary to try to separate constituents, and to see if any others were there. With this view I tried the following methods:—

*Method 1.*—Boiled the fine powder, crushed between agates in water acidulated with boric acid, and treated the residue B.B. in a bead of boric acid.

*Method 2.*—Fused the fine powder B.B. in a bead composed of equal parts of boric and phosphoric acids; boiled the resulting bead as in (1), decanted the solution, and treated the residue B.B. in boric acid.

*Method 3.*—Crushed the mineral to a fine paste between agates with some drops of water and crystals of boric acid; boiled in fresh boric acid water, and treated residue B.B. in boric acid.

*Method 4.*—Crushed the mineral to a fine paste between agates with sodium carbonate and water; fused the paste B.B. on aluminium plate; crushed the resulting ball with (a) forceps, boiled the powder in boric acid water, and treated the residue B.B. in boric acid.

*Method 5.*—Crushed the mineral to a fine paste between agates with 3 drops of a strong solution of phosphoric

\* These references apply to my work, "Pyrology, or Fire Chemistry," Spön: 1875. Any new manipulations will be detailed in foot-notes.

acid, washed it into a Berlin capsule with distilled water, and boiled for three minutes; evaporated the solution to dryness in a platinum capsule, and treated the residuum B.B. in boric acid.

As these five differing methods of treatment—which occupied some weeks—all failed to give a decided result, *i.e.*, the residue obtained gave only transparent matter, like melting ice, in a bead of boric acid before the blowpipe, or, in the words of Des Cloizeaux and other writers on silicates, *Adularia* is “inattaquable par les acides,” I made a sixth essay, which is detailed as follows:—

*Method 6.*—(1.) Fused about 50 m.grms. of fine powdered *Adularia* in a bead of phosphoric acid before the blowpipe; an undissolved transparent mass ( $\text{SiO}_2$ ?), the bead becoming gelatinous and yellowish like horn by transmitted light. (This operation is founded on the previously-ascertained fact that alumina is thus rapidly dissolved, while silica remains insoluble.)

(2.) Boiled the bead (1.) in a Berlin capsule over a Fletcher pyrocone, extracted the siliceous mass, decanted the solution (which had a sweet sub-acid taste) into a test-tube, added a few drops of solution of sodium hydrate, and boiled gently over the pyrocone; a yellowish white, flocculent, slowly falling precipitate (of aluminium hydrate?)

This precipitate, dried on a red-hot platinum spatula, and treated in a bead of boric acid, afforded transparent matter, which seemed to rapidly dissolve B.B. in the bead, but on close lens examination showed minute rounded white fragments (alumina).

#### Collection of Evidence.

We thus find that *Adularia* is “attackable” by one acid at all events; that the specimen here examined contains no lime, a large proportion of silica, a considerable quantity of alumina, between 5 and 20 per cent potash, and by Method 2 (which there is not space here to detail) a brownish residue showing in a boric acid bead minute rusty-brown balls, which is the reaction of sesquioxide of iron.

Other minerals of the same class will, of course, occupy much less space than the above, and will be examined only by Methods 2 and 6.

London, August 29, 1877.

## ON OPTICALLY INACTIVE SUGAR.

By W. E. HALSE and J. STEINER.

SOME time ago we received for analysis a sample of liquor taken from the hold of a ship which had brought over a cargo of cane-sugar from the Colonies. This liquor represented the drainings of the sugar mixed with the bilge-waters. It had a dark brown colour, a salt and sweet taste, and had an odour like molasses. The analysis showed—

Organic matter .. ..	42.50
Water .. ..	51.75
Ash.. ..	5.75

The ash consisted of the mineral matter of the seawater and the soluble part of the ash of the cane-sugar.

The liquor was clarified with sub-acetate of lead, and the excess of the lead removed by sulphurous acid, and then tested in the general way. It showed no influence on the polarised ray, but reduced the copper solution to an amount equal to 27.70 per cent of glucose. The same result was also obtained when it was tested without being clarified. As to the nature of this sugar, two cases were possible: it either might be a mixture of levulose and dextrose, or levulose and saccharose in such a proportion that their opposite rotations compensated each other; or simply a sugar having no action whatever on polarised light.

In order, therefore, to identify this sugar, we submitted the liquor to the following tests:—To a part of it some yeast was added. Fermentation soon set in and progressed rapidly. Whilst in this state it was again tried in the polariscope, but no rotation was observed. Had it been a mixture of levulose and dextrose a levo-rotation would have made itself evident now, as dextrose ferments and disappears first in such a case.

Another part of the liquor was treated with dilute alkali, and heated with a view of destroying the levulose, and thus obtaining dextro-rotation had cane-sugar been present; but again no rotation was noticed. The sugar in this liquor is therefore not a mixture, but a special kind of a sugar which is optically inactive.

Chemists who have to deal with cane-sugar are often led to believe from the results of their analyses that the fruit-sugar present in it is without influence on polarised light, but it may be considered an exceptional case to meet with molasses containing only optically inactive sugar.

Laboratory, 21, Mincing Lane.

## NOTICES OF BOOKS.

*Medical Science in Relation to the Voice as a Musical Instrument.* By LENNOX BROWNE, F.R.C.S. Edinburgh. (Read before the Musical Association of London, and reprinted from the *Transactions*.) London: Chappell and Co.

THIS pamphlet can scarcely be appreciated save by musicians, or by such as have studied acoustics and the physiology of the vocal organs from a musical point of view. The author remarks that he has had analyses made of every variety of patent voice lozenges, and finds that they all contain cayenne pepper or some analogous irritant. He blames singing-masters for prescribing to their pupils remedies for affections of the voice of which they know nothing, except that such have been serviceable to themselves or their friends under diseased conditions, probably totally different. The vocalist is warned not to be afraid of air, but reminded that he should avoid sudden changes of atmosphere and also dust. “He should never foster the idea that alcoholic stimulant of any kind is necessary to the exercise of his art any more than it is to that of the painter or the author.”

*The Retrospect of Medicine.* Edited by W. BRAITHWAITE, M.D., and JAMES BRAITHWAITE, M.D. Vol. lxxxv., January to June, 1877. London: Simpkin, Marshall, and Co.

IN a paper on the use of peroxide of hydrogen for preventing the spread of scarlet fever and smallpox we find the interesting statement that pus-cells exalt the chemical activity of this compound, and give it “the oxidising powers of ozone.” Dr. S. Wilks, in an article on “Alcoholism,” maintains that alcohol, strictly speaking, is not a stimulant, but an anæsthetic. He shows that though not a necessary of life—an indispensable article of food—it is at the same time a useful medicine, and is called for in a quick pulse and high temperature. In cases of wasting, especially in children, it is often more effectual than cod-liver oil. The author drily remarks—“You may have observed that whiskey has taken the place of brandy in the medical dietary. I have failed to discover the reason, so I suppose it is a secret of the distillers.” Dr. W. G. Smith reviews the various tests proposed for the detection of bile-pigment, and gives the preference to the acetic or phosphoric solution of peroxide of lead, and to peroxide of hydrogen. Tincture of iodine is exceedingly sensitive, giving like the two former reagents a brilliant

green colour in urine containing bile-pigment, but it has the disadvantage of being in itself coloured. The value and delicacy of the nitric acid test are less than what is commonly supposed.

For generating sulphurous acid as a disinfectant Mr. Keates proposes the combustion of bisulphide of carbon in a lamp so contrived as to prevent the volatilisation of the liquid.

This volume of the "Retrospect," like most of its predecessors, is rich in matter valuable to the medical practitioner, though the passages interesting to the chemist are necessarily few.

*Programme of the Royal Rhenish-Westphalian Polytechnic School at Aachen for the Course 1877 to 1878.\**

WE have repeatedly found occasion to admire the arrangements of this college and the thoroughness of its educational courses, especially as regards chemistry and its application to the arts. We have now merely to add that it maintains the high character it has already acquired.

*The Chemist's Manual: a Practical Treatise on Chemistry, Qualitative and Quantitative Analysis, Stoichiometry, Blowpipe Analysis, Mineralogy, Assaying, Toxicology, &c.* By HENRY A. MOTT, jun., Ph.D. New York: Van Nostrand.

THIS work, the author tells us, has sprung from a collection of notes and tables compiled originally for his own convenience. Gradually the resulting memoranda became too bulky for the pocket, and assumed the form of a manuscript book lying ready for reference upon the laboratory table. At the request of a number of scientific men it has appeared in its present shape as a substantial volume of some six hundred pages.

The contents, as appears from the very title, are of a somewhat promiscuous character. There is, in the first place, a section on qualitative analysis. Here we find the characteristic reactions of the metals (arranged in the ordinary analytical groups) stated with considerable minuteness, the rarer elements not being omitted. In equations used to exemplify reactions the author uses the  $\Delta$  to signify heat. Thus, in explaining the production of chromic oxide and oxygen gas from mercurous chromate, he gives the following formulæ:—



Such equations have the disadvantage that the symbol  $\Delta$  never reappears on the other side, and they might lead the reader to believe heat to be a material element. Upon this section follows a scheme for the qualitative examination of an unknown substance; a "complete table of analytical chemistry," by James Hayward: a scheme for qualitative analysis without the use of sulphuretted hydrogen or hydrosulphate of ammonia, drawn up by Zettnow, and destined we presume for the use of persons with eminently delicate olfactories; the Stas-Otto scheme for the recognition of the organic alkalies; Trapp's instructions for the same purpose; Wenzell's table of the tests for strychnia; the reactions of fatty oils, with acids and alkalies, taken from "Watts's Dictionary of Chemistry;" Glassner's scheme for the analysis of fatty oils; tables of the specific gravities, optical properties, and boiling-points of essential oils and hydrocarbons derived from such; Attfield's table of official tests for impurities in pharmacopœial preparations; Grothe's table of the reactions of metallic salts with the alkalies, &c., in presence of non-volatile organic matter, such as citric acid, sugar, &c.

Next follows a section on specific gravities, with hydrometric tables, one of which shows the degrees of Twaddle in comparison with direct specific gravity, but singularly only as far as 28°.

\* Programm der Koeniglichen Rheinisch Westfalischen Polytechnischen Schule zu Aachen.

The mineralogical chapter consists of an account of the sources of those elementary bodies which, in a simple or combined state, are used in the arts. Amongst these we find strontium, whilst barium, whose practical applications are far more extensive, is omitted. The localities of the different minerals are very naturally stated with a preponderating reference to America. Towards the end of the chapter we find a geological section of the Oil Creek region, and an account of the distillation-products of crude petroleum.

Upon this follow a section devoted to stoichiometrical calculations and a table of solubilities.

The chapter on quantitative analysis consists of instructions for determining the constituents of a number of bodies, such as iron ores and slags, chrome-iron, pig-lead, nickel ore, copper ore, manganese, manures, &c., the substances selected being probably such as have principally come under the author's professional notice. Saccharimetry is explained in detail.

Next follows a section on assaying—a term, by the way, which we have never seen defined with accuracy as distinguished from quantitative analysis. Some writers seem to call every commercial analysis an assay; some restrict the term to operations where only one constituent of a compound is estimated; whilst others, like our author, seem to understand by an assay an analysis performed in the dry way.

A curious chapter entitled "Analysis of a Man" gives the total ultimate composition of a human body of the weight of 154 lbs., and of the principal vital fluids, secretions, &c.

Next follows an abstract of Mendeleeff's views on the classification of the elements, and a "chronological table of defunct elements;" or, in other words, a list of bodies supposed at one time or other to be elementary, but which were rejected on further scrutiny. Among these ex-elements, which number no fewer than 42, we meet with our old friends andronia and thelyke. It is curious that the name thallium was for a short time claimed by one of these supposed simple bodies, discovered by Owen in 1852.

Upon this follow an assortment of tables, one of which shows the "formulæ of frequently occurring substances." Here we find copperas or green vitriol written simply as  $\text{FeSO}_4$ , the  $7\text{H}_2\text{O}$  being omitted.

A short section on poisons and their antidotes includes such comparatively harmless substances as iron and phosphoric acid, but omits the compounds of chromium and of tin, the former of which are exceedingly formidable, and from their extensive applications in the arts very liable to occasion accidents. The homœopathic treatment is indicated in every case.

To pass a definite judgment upon a work like this is exceedingly difficult. Probably most chemists will find in it no small amount of matter which is not merely useful, but which is sometimes not easy to meet with when required. On the other hand, a large part of the contents will, we think, be regarded as superfluous by a majority of the profession. The author declares in his preface that "every scientific man should compile his own pocket-book, as he proceeds in study and practice to suit his particular business," and in so saying he admits that a compilation of this kind must be of very different value to different persons. Typographical errors are numerous, especially in the names of the authorities cited.

*Thirteenth Annual Report of the Alumni Association of the Philadelphia College of Pharmacy. 1877.*

THIS pamphlet contains an introductory lecture to the fifty-sixth session of the Philadelphia College of Pharmacy, by Prof. J. M. Maisch, in which particular weight is laid on the pharmaceutical products at the late Centennial Exhibition.

# CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 7, Aug. 13, 1877.

**Best Conditions for the Use of Galvanometers.**—M. Th. du Moncel.—This paper is not suitable for abstraction.

**Vapour of Chloral Hydrate.**—M. L. Troost.—The author proves that chloral hydrate exists in the gaseous state, and that its equivalent corresponds to 8 volumes.

**Certain Properties of Cadmium Sulphide.**—M. Ditte.—Cadmium generally ranks among the metals whose sulphides are insoluble in alkaline sulphides; it may, nevertheless, happen that a liquid containing cadmium is not precipitated by the hydrosulphate of ammonia, but that the metal is found in the filtrate obtained by treating with this reagent the sulphides formed by the action of a current of hydrosulphuric acid. Sulphide of cadmium is in fact soluble in hydrosulphate of ammonia at common temperatures. If a few drops of this reagent are added to a dilute solution of cadmium we obtain at first the characteristic yellow precipitate, which dissolves, however, if the alkaline sulphide is added in excess. The same thing happens if cadmium sulphide is formed at first by the action of sulphuretted hydrogen and is then treated with hydrosulphate of ammonia; the liquid becomes clear and the precipitate disappears entirely. This solubility cannot be ascribed to the presence of a small excess of ammonia in the hydrosulphate, for this base, though it readily dissolves certain salts of cadmium, is without action upon the sulphide at common temperatures. The solubility of cadmium sulphide augments on raising the temperature of the ammoniacal salt, and at 60° it is about double what it is in the cold. Even if the cadmium sulphide, after precipitation with H<sub>2</sub>S, is boiled, it is still soluble in the hydrosulphate. The solution made at 60° if left in a closed vessel deposits a part of the cadmium sulphide which it had taken up, and if the cooling is very slow it deposits small transparent crystals, which are anew soluble in hydrosulphate of ammonia. If a solution of hydrosulphate of ammonia saturated with cadmium sulphide is slowly evaporated over quicklime we obtain upon the sides of the receiver a white pulverulent deposit of ammonium sulphide, whilst a mixture of crystals of sulphur and of cadmium sulphide remains at the bottom of the vessel. The sulphur separates in small octahedra and in plates generally white, becoming yellow slowly on contact with the air, but rapidly on friction. The sulphide of cadmium is deposited in aggregations of very small crystals. The saturated solution of cadmium sulphide contains about 2 grms. per litre, a solubility slight but still much greater than that of copper in the hydrosulphate of ammonia, where yet it is customary to employ in preference the sulphides of potassium or sodium. If a solution contains but very little cadmium this metal may totally disappear under the influence of hydrosulphate of ammonia, without its reappearing in the precipitate which might be expected to contain it. Potassium and sodium sulphides do not dissolve it appreciably even at 50° or 60°, and it seems therefore to use these alkaline sulphides for the separation of cadmium, as in the case of copper. But when hydrosulphate of ammonia is employed to separate the sulphides which it dissolves from those which are insoluble, it is necessary to search for cadmium not merely in the residue but also in the filtrate.

**Certain General Properties of Metallic Sulphides.**—MM. Ph. de Clermont and H. Guiot.—An ammoniacal salt heated to 100° in a distillatory apparatus with water and a metallic sulphide yields ammonium sulphide, but

when all the ammoniacal salt is decomposed and the disengagement of ammonia has ceased, there is still a production of sulphuretted hydrogen due to the decomposition of the metallic sulphide in presence of water. The authors' experiments, which prove the decomposition of the sulphides by water at 100° with formation of a metallic oxide and of sulphuretted hydrogen, contribute a new argument in support of the view that hydrogen is a metal. It displaces, in fact, in these reactions true metals, and forms a sulphur compound more stable at these temperatures, *i.e.*, sulphuretted hydrogen. Moist carbonic acid decomposes manganese sulphide at common temperatures, but in presence of boiling water the decomposition is very rapid. At common temperatures hydrogen does not decompose rose-coloured manganese sulphide. The green hydrated manganese sulphide is decomposed by carbonic acid, but less rapidly than the rose sulphide. Iron sulphide is likewise decomposed and more slowly than the above, contrary to the assertion of Wagner. Green anhydrous manganese sulphide suspended in water is decomposed still more slowly. In all these cases there is produced a metallic carbonate and sulphuretted hydrogen. The sulphides of silver, lead, and antimony resisted the action of carbonic acid.

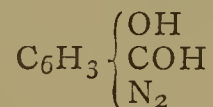
*Gazzetta Chimica Italiana,*  
Anno vii., 1877, Fas. vi.

**Note on Sordidin.**—E. Paterno.—In his memoir on usnic acid the author announced the discovery of a new proximate principle found in *Zeora sordida*, to which he gave the name of sordidin. Having now obtained it in a state of purity he finds that it contains—

Carbon .. .. .	53.06
Hydrogen .. .. .	3.40

and that it may be represented by the formula C<sub>13</sub>H<sub>10</sub>O<sub>8</sub>.

**Nitro-Derivative of Para-oxybenzoic Aldehyd.**—G. Mazzara.—The compound in question, mono-nitro-para-oxybenzoic aldehyd, is expressed by the formula—



It has the characters of a strong acid, and readily decomposes carbonates. Its potassic salt,—



crystallises from water in splendid gold-coloured tablets, and loses its crystalline water about 70°.

**Quantitative Separation of Iron and Manganese in Ferro-manganic Minerals.**—Dr. Angiolo Funaro.—Reserved for more extended insertion.

**Chromic Acid as a Reagent for Malic Acid.**—G. Papasogli and A. Poli.—If to 5 c.c. of water containing a few milligrms. of malic acid, free or combined, there are added a few drops of dilute sulphuric acid along with a crystal of bichromate of potash, and the liquid is then raised to a boil, it passes from a yellow to a green colour, emitting a distinct odour of the ripe fruit. As this reaction is not common to the citric and succinic acids, it seemed that it might be employed with good success for the detection of malic acid when mixed with the two others. The authors recommend the following modification of the process of Fresenius:—Having obtained the precipitate of the calcic salts of the acids in alcohol, the latter body must be completely driven away, when a small quantity of the precipitate is taken, treated with dilute sulphuric acid, the precipitate of sulphate of lime produced is filtered off, and to the filtrate a small crystal of bichromate of potash is added, and the liquid is several times raised to a boil. It is then needful to observe—(1) If the liquid still remains of a yellow colour, even after a prolonged ebullition, this indicates the presence of succinic acid alone. As a check test the remnant of the precipitate may be tested with ferric chloride. (2) If the liquid passes from a yellow to a

green without giving off the smell of ripe fruit, this indicates the presence of citric acid alone or accompanied with the succinic. (3) If the liquid turns green, and gives off the odour of ripe fruit on cooling—an odour which recalls that of medlars when fully mature—the presence of citric acid is indicated.

Observations on a Memoir by G. Musso.—Prof. Damiano Macaluso.—A mathematical paper, not suitable for abstraction.

Action of Light and Carbonic Acid upon Aqueous Solutions of Iodide of Potassium, and on Ozonoscopic Paper.—G. Pellagri.—Carbonic acid in quantity, especially in the form of a current, liberates hydriodic acid from potassium iodide. If a current of carbonic acid is passed over a mixture of iodide and iodate of potassium, iodine is liberated without the intervention of light. Direct light sets free iodine in ozonoscopic paper, and therefore also in a solution of iodide of potassium without the intervention of carbonic acid and of ozone.

New Reaction for Morphia.—G. Pellagri.—The solution of the suspected matter is evaporated at a gentle heat; the residue is treated with concentrated hydrochloric acid to which a small quantity of pure concentrated sulphuric acid has been added; and the mixture is evaporated in the oil-bath at from 100° to 120°. Whilst the hydrochloric acid disappears, a most beautiful purple colour begins to form on the edges of the capsule, which is not masked by the carbonisation of the organic matter; then a red colour extends downwards the centre of the capsule, and when all the hydrochloric acid has disappeared the remaining sulphuric acid appears of a red colour. At this moment the capsule is carefully taken out of the bath, a little hydrochloric acid is added, and the whole is neutralised with bicarbonate of soda. A violet colour is then produced, which does not alter in the air nor dissolve in ether. If a drop of ioduretted hydriodic acid is now added the violet colour changes to a green, which dissolves in ether with a purple colour. Codeia gives the same reactions, but as morphia is insoluble in ether the two may be easily distinguished. Brucin treated in the same way, on neutralisation with bicarbonate of soda, gives a beautiful azure, which turns red with iodine.

*Archives Néerlandaises des Sciences Exactes et Naturelles*,  
Tome x., 5me Livraison.

Relations between Physical Properties and Chemical Constitution.—J. A. Roorda Smit.—Of late increased attention has been given to the connection between the physical properties of bodies and their chemical composition. M. van 't Hoff, in a work entitled *Chemistry in Space* ("La Chimie dans l'Espace") has considered the constitution of bodies in a space of three dimensions, and has detected a remarkable relation between chemical constitution and the power of acting upon polarised light. M. Spring (*Ann. de la Soc. Géol. de Belgique*, t. ii.) has pointed out a connection between crystalline form and the valence of the atoms constituting chemical compounds. M. Smit hopes to be able to give an explanation of isomerism, allotropy, &c. He thinks that the properties of compounds, physical as well as chemical, depend not merely on chemical composition as admitted at present, but on true molecular magnitude and correlative constitution, hitherto unknown. He considers that the only explanation of the facts in question is to take another molecular magnitude than that hitherto adopted, admitting that the crystalline molecules are polymeres of the vapour molecules, and that a different degree of polymerisation is the cause of the phenomena of dimorphism and allotropy. The paper, which does not admit of complete abstraction, will repay a careful perusal.

Tome xi., 3me Livraison.

Description of the Compass of Intensity.—F. J. Stamkart.

Note on the Use of the Compass of Intensity to find the Deviation of the Magnetic Needle on Ship Board.—F. J. Stamkart.

Horizontal Intensity of Terrestrial Magnetism.—F. J. Stamkart.—These three papers are not adapted for abstraction.

Tome xi., 4me Livraison.

Artificial Digestion of Cellulose.—T. H. MacGillavry.—The mucous membrane of the vermicular appendage of the cœcum in rabbits yields a secretion, which in a mixture having an alkaline reaction transforms cellulose into a matter soluble in water. This matter if submitted to Brücke's test behaves like glucose, with which it will probably be identified on a closer examination.

Tome xi., 5me Livraison.

This issue contains no chemical or chemico-physical matter.

Tome xii., 1me Livraison.

Determination of Quinine in Cinchona Barks by Means of the Polaristrobometer.—A. C. Oudemans, Jr.—The author, in his memoir on the specific rotatory power of the principal cinchona alkaloids, expressed the opinion that the use of the polaristrobometer might become a useful adjunct in the quantitative analysis of mixtures of two or more of these alkaloids. He has now endeavoured to show by examples that the disturbing influences exerted by variations in the degree of concentration, or by the simultaneous presence of different alkaloids, are so slight that this method of determination gives results much more accurate than those obtained by purely chemical procedures. He finds that it is possible to determine by means of the polaristrobometer the amount of quinine in the mixed tartrates of quinine and cinchonidin as obtained by precipitation from the solutions of the barks. His result is a refutation of the unfavourable opinion which Hesse has too precipitately passed (*Ann. der Chemie u. Pharm.*, clxvi., p. 230) on the utility of such determinations.

On Cuprous Hydride.—W. K. J. Schoor.—On adding to dilute sulphuric acid and metallic zinc a solution of sulphate of copper this hydride is formed. After filtering and washing it appears as a brown powder, which evolves hydrogen on contact with pure water. If treated with hydrochloric acid pure hydrogen escapes and cuprous chloride dissolves, from which hydrated cuprous oxide may be precipitated. The composition of the hydride is  $\text{Cu}_2\text{H}_2$ .

*Revue Universelle des Mines*,  
March and April, 1877.

This issue contains no original chemical matter.

*Beiblatter zu den Annalen der Physik und Chemie*,  
No. 1, 1877, Band 1, stück 1.

On Saline Solutions and Combined Water.—F. Guthrie.—An abstract of certain papers by Dr. Guthrie to be found in the *Phil. Mag.*, xlix., 1, 206, 266; 1, 49, 351, 446; 2, 211.

Transition State between Gases and Liquids. Inaugural dissertation (Leiden: Sijthoff, 1873).—J. D. van der Waals.—A mathematical paper, incapable of useful abstraction.

Preliminary Notice on Further Researches concerning the Physical Properties of Matter in the Liquid and Gaseous Condition at Different Temperatures.—T. Andrews.

Gaseous Condition of Matter.—T. Andrews.—The former of these papers is taken from the *Phil. Mag.*, i., p. 78, and the latter from the *Proc. Royal Soc.*, xxiv., 455, April 27, 1876.

**Specific Heats of Saline Solutions.**—J. C. Marignac (*Ann. der Chemie*, viii., 410).—An investigation of the question whether the specific heats of saline solutions can be calculated from the specific heats of their constituents, at least approximately, as is the case with specific gravities. If this is not the case can relations be traced to other properties of the salts, especially to their tendency to form definite crystalline hydrates? The author finds that the specific heat of saline solutions is generally less than the sum of the specific heats of their individual constituents. This rule is not, however, free from exceptions and does not hold good with most acetates.

**Experiments on the Acoustic Properties of Metals, Woods, and Stones.**—C. Decharme (*Inst.* iv., 225, &c.)—The author comes to the conclusion that the results differ somewhat with different specimens.

**Investigations on the Spectra of Non-metallic Bodies.**—J. Angström and T. K. Thalén (*Acta Soc. Upsal.*, vol. ix., 2 plates).—A minute examination of the spectra of carbon and nitrogen. The authors make the following preliminary remarks:—"We are far from entertaining the view that with an increasing temperature or even an augmentation of the mass of the incandescent gases the number of the luminous bands cannot increase. As little do we deny that the brightness of certain bands may increase more rapidly than that of others. On the other hand the assertion of certain physicists that lines originally visible may totally disappear, thus totally altering the character of the spectrum, is theoretically improbable and contradictory to experience. We do not deny that an elementary body may under certain circumstances give different spectra. Thus the absorption spectrum of iodine is totally different from the system of bright lines which this same substance gives when exposed to a discharge of sparks. Any body capable of allotropic modifications shows also different spectra, provided always that this capability still exists in the gaseous condition and at the temperature in question. On the supposition that allotropism occurs in gases, every allotropic condition will have a certain absorption spectrum; but if only one of these conditions can bear the temperature of incandescence only one spectrum will be obtained at this temperature, the ordinary line spectrum."

**A New Relation between Electricity and Light. Double Refraction in Dielectric Media.**—J. Kerr.—From the *Phil. Mag.*, i., 337, 446.

**Repetition of Experiments on a New Relation between Electricity and Light.**—J. E. Gordon.—From the *Phil. Mag.*, ii., p. 203, 1876.

**Residue of the Leyden Jar.**—J. Hopkinson.—Taken from the *Phil. Mag.*, ii., p. 314.

**New Electric Lamp Invented by M. Jabloschkoff.**—M. Denayrouze.—*Comptes Rendus*, lxxxiii., p. 813, 1876.

## MISCELLANEOUS.

**University of London.**—The following is a list of those who have passed the recent Examination for Honours in Chemistry and Experimental Physics:—First B.Sc. and Preliminary M.B. conjointly (*Chemistry*):—First Class. C. F. Cross, First B.Sc. (Exhibition), King's and Owens Colleges, and W. H. Thomas, First B.Sc. (disqualified by age for the Exhibition), Royal College of Chemistry, equal. Second Class. A. H. N. Lewers, Prel. Sci., University College; A. Barron, Prel. Sci., Owens College. Third Class. C. E. Cassal, Prel. Sci., University College; H. I. Bell, First B.Sc., private study; H. Marriott, First B.Sc. and Prel. Sci., Owens College, and H. Pearce, First B.Sc., University College, equal; F. W. Stoddart, First B.Sc. and Prel. Sci., University College,

Bristol. (*Experimental Physics*):—First Class. J. Larmor, First B.Sc. (Arnott Exhibition and Medal), St. John's College, Cambridge; M. J. Jackson, First B.Sc. (Arnott Medal), University College. Second Class. H. E. Harrison, First B.Sc., University College, and H. Pearce, First B.Sc., University College, equal. Third Class. E. L. Adeney, Prel. Sci., Guy's Hospital; O. J. Currie, Prel. Sci., Guy's Hospital.

**Russian Scientific News.**—Prof. N. Sokoloff has examined some methods for the extraction of hydrocyanic acid from its solutions by distillation. Solutions of this acid being distilled, the acid separates very slowly: in the first portions of the distillate the acid may be discovered by its reaction on a mixture of NaHO, FeSO<sub>4</sub>, and FeCl<sub>3</sub>. In the following portions of the distillate, and in weak solutions containing less than 0.3 milligram of the acid in 100 c.c. of water, the above-mentioned reaction cannot be used, and the presence of HCN can only be detected by collecting the distillate in a condenser with a solution of silver nitrate. From alcoholic and aqueous solutions of potassium cyanide the hydrocyanic acid is liberated by passing a current of carbonic acid. The acid in this case is collected into a 5 per cent aqueous solution of potassium hydroxide; in this solution the acid is tested by Liebig's method. M. Geschus has made some new experiments on the passage of the electric current through an electrolyte when there is a difference in the dimensions of the electrodes. The liquor used was a weak aqueous solution of sulphuric acid. One of the electrodes was a platinum crucible containing the liquor, and the other was a platinum wire, which was immersed in the liquor to various depths. Experiments proved that on connecting the crucible with the anode of a strong battery (20 to 30 cells), and placing the wire attached to the cathode into the liquor, that the current was strongest when there was a distance between the wire and the bottom of the crucible. When the wire touched the crucible no increase of current was remarked. New rules for Government orders of steel rails have been published. The presence of phosphorus in steel for rails is allowed in the following proportions:—

	Per Cent.			
Phosphorus	0.05—0.06	0.06—0.08	0.08—0.09	0.09—0.10
Carbon	0.40—0.36	0.36—0.32	0.32—0.29	0.29—0.25

The Government has thus adopted a somewhat new and not well investigated metallurgical rule—the less carbon the steel contains the more may be the percentage of phosphorus in the metal. The water of the Neva, used by the inhabitants of St. Petersburg, is at present much injured by numerous works situated on the river. A new project has been devised by the town in order to supply water by an aqueduct from Dooderhoff, a village situated on the south of the town. 1000 parts of the Dooderhoff water contains 0.286 part of solids and 0.254 part of free and combined carbonic acid. The composition of the solid matter is the following:—

Calcium carbonate	..	..	59.23
Magnesium carbonate	..	..	34.14
Calcium sulphate	..	..	1.55
Magnesium chloride	..	..	0.83
Organic matter	..	..	2.80
Silica	..	..	0.49
Sodium chloride	..	..	traces

99.04

SERGIUS KERN.

Obouchoff Steel Works.

## NOTES AND QUERIES.

**Concentrating Sulphuric Acid.**—Can anyone oblige by informing me whether any better method of evaporating chamber-acid at 110° to 140° Twaddle than boiling in a leaden pan has yet become available?—B. O. V.

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# THE CHEMICAL NEWS.

VOL. XXXVI. No. 922.

## THE CHEMICAL PROFESSION.

ALL our readers must be aware that the question of a professional organisation for chemists has been very fully debated both in our own columns and in some of our contemporaries, and that much difference of opinion prevails concerning the exact steps to be taken, although the necessity for such action is admitted by all concerned. Whilst, however, gentlemen of scientific eminence and established reputation are thus labouring to raise the status of themselves and their brethren, to exclude from the ranks of the profession all who are either morally or intellectually incompetent, and to win for chemistry and for those who live by its practical applications a more honourable position, it is painful to find that certain other persons are labouring diligently—and we fear successfully—in the very opposite direction. Correspondents have drawn our attention to circulars—apparently widely circulated—in which certain analytical practitioners offer to perform the determination of almost every element in whatsoever combination, not merely for a fixed charge, but for one ridiculously low. We have before us whilst writing a document of this kind, in which the advertiser offers to perform the “commercial analysis” of a soil for from five shillings to a guinea! Now if we call to mind the number of determinations which must be made to throw any useful light upon the agricultural capabilities of a soil, and the extreme accuracy required, we must declare that at such a scale of charges no one working carefully and conscientiously could earn the wages of a day-labourer. If analytical chemistry is to be exercised upon such terms we must advise students that stone-breaking is, of the two, the more respectable profession! Returning to the circular we find that a determination of nickel or cobalt will be made for five shillings, and one of mercury (or hydrargyrus, as it is here called) for the same sum. A quantitative determination of arsenic—for anything stipulated to the contrary in the body of a poisoned man or animal—can also be had at the above modest figure. What would be thought among legal practitioners of a solicitor who circulated a price-list for conducting all manner of cases, and who moreover descended in some instances to one-fifth or even one-tenth the usual charges? The cases, we maintain, are strictly analogous. The determination of an element is not a task which invariably requires the same amount of time and skill. It may be in one particular instance easy and simple, and in another it may be rendered tedious and difficult by the presence of other bodies.

Chemical practitioners who seek to obtain or extend a connection by under-bidding their colleagues sometimes profess to have secret methods which enable them to execute analyses with much more ease than can be done by any known process. But what, we ask, is said in the medical profession of any practitioner who boasts of secret methods which he refuses to submit to competent judgment? Is he not at once designated by a name more emphatic than pleasant? We are unable to see that secret methods are more trustworthy in chemistry than in medicine. Any commercial analysis may possibly lead to litigation, and what would judges or opposing counsel say both to and of an expert who, whilst swearing to certain results, wished to conceal the processes by which such results had been reached? We know how we should prompt counsel if we were engaged on the opposite side. We cannot help expressing a hope that analysts who issue such circulars may, on reflection, feel how the injury they are doing to the profession must in the long run rebound

upon themselves, and that they will see the necessity of acting for the future in a manner less unworthy of gentlemen and men of science.

## THE ACTION AT A HIGH TEMPERATURE OF ALKALI-WASTE ON MANGANESE CHLORIDE, AND THE SPONTANEOUS OXIDATION OF MANGANESE SULPHIDE WITH INCANDESCENCE.

By WATSON SMITH, F.C.S.

THE following experiments were made during the year 1869, and the results may possibly be interesting to manufacturers and technical chemists, as well as from a theoretical point of view to some extent. A quantity of fresh alkali-waste was rapidly dried, and mixed with a due proportion of crude manganese chloride, obtained from the spent liquors from the stills for generating chlorine in the bleaching-powder process. This mixture was placed in a deep crucible with well-fitting lid, and exposed to a red heat over the gas blowpipe, or in a furnace. The mass soon began to fuse, and during the reaction which took place the bluish flame of burning sulphur made its appearance for a short time, issuing out between the lid and the crucible. In one or two cases the bottom of the crucible was fused out, the clay of the vessel being evidently acted upon by the ingredients. The mass in the crucible after the fusion was of a dark brown or black colour. The crucible with its contents was placed in a basin and boiled out with water repeatedly, and the solution with precipitate was thrown on a filter. A mixture of manganese sulphide with some brown oxide of manganese, and insoluble matters, was found on the filter, whilst the filtrate contained calcium chloride abundantly, with a little manganese sulphate, and undecomposed chloride. After washing, the residue on the filter was carefully dried in the water-bath, and pulverised finely, when, on slightly heating, the mass at once became incandescent and burnt like tinder. The bluish flame of sulphur slightly made its appearance, sulphur dioxide being disengaged to a small extent. Finally, a brown powder remained consisting of a mixture of manganese brown oxide, and manganese sulphate. This powder was treated with hot distilled water, filtered, and washed. Brown oxide of manganese remained on the filter, and the filtrate contained a considerable amount of manganese sulphate. The two by-products were thus divided into three bodies, all of which are at least to some extent useful, viz., calcium chloride, manganese sulphate, and brown oxide of manganese. The second was ignited with an equivalent weight of sodium chloride, the mass dissolved in water, and the not too concentrated solution set to crystallise, a crop of Glauber's salt was obtained. The third was treated with hydrochloric acid, when chlorine was liberally evolved. The sulphur dioxide evolved as above mentioned would, of course, be a useful product.

I have noticed recently a note by MM. de Clermont and H. Guiot in the *Comptes Rendus* for the 9th July, an abstract of which appeared in the CHEMICAL NEWS, vol. xxxvi., p. 61, to the effect that the authors have discovered that precipitated manganese sulphide, dried between blotting paper, and then over concentrated sulphuric acid *in vacuo*, when afterwards exposed to the air, becomes red-hot, and burns like tinder, a mixture of brown oxide of manganese and manganese sulphate being left behind. Now from as far back as the year 1869 this fact of the spontaneous oxidation of manganese sulphide with incandescence has been familiar to me, though I confess I have never before published the matter, and so far only as that is concerned are MM. de Clermont and Guiot in advance of me. I ought to say, however, that

working as I did, with a sulphide of manganese not quite pure, I found that the incandescence did not set in until after spreading out the powder on a plate, and sometimes gently warming.

If ferrous or ferric chlorides be fused in like manner with alkali-waste a mass consisting of calcium chloride and ferrous sulphide is obtained. The two bodies in the mixture are separated by treatment with water and filtration, ferrous sulphide being left on the filter. On igniting the ferrous sulphide, sulphide dioxide is evolved, and ferric oxide remains behind.

## ON SOME NEW RESEARCHES ON THE METAL DAVYUM.

By SERGIUS KERN, St. Petersburg.

THE weight of the davyum ingot was 0.27 gm. This ingot was dissolved in aqua regia, and the action of different reagents on the davyum chloride solution was more closely examined.

Potassium hydroxide gives a precipitate of a light lemon colour, which easily dissolves in acids, even in concentrated acetic acid. This hydrate of davyum dissolved in nitric acid yields on evaporation a brownish mass of a nitrate of davyum. By ignition the nitrate compound gives a blackish powder, probably the davyum monoxide. Acid solutions of davyum chloride are precipitated by yellow prussiate; in this case a brownish precipitate is obtained. Potassium cyanide dissolves readily davyum chloride; the solution being evaporated yields big prisms of a double cyanide salt of davyum and potassium. In this double salt the potassium may be replaced by many metallic elements. By passing through solutions of such salts hydrogen sulphide davyum-cyanic acid is obtained in the form of a crystalline red mass, which, on being even gently heated, is decomposed.

Hydrogen sulphide in davyum acid solutions gives a brownish precipitate of davyum sulphide; on being dried it turns black. This compound easily dissolves in alkaline sulphides, yielding probably sulpho-salts.

As I mentioned in my first communication on the new metal, the davyum chloride with potassium sulphocyanide gives a red colouration. Several metals give the same reaction, and as it was interesting to show that this reaction of davyum is not identical with the reactions of other metallic salts, the action of potassium sulphocyanide was more closely examined. Careful qualitative analyses showed no presence whatever of iron; no other metals were present, and the davyum was dissolved in aqua regia, the solution was evaporated, and the resulting mass of davyum chloride was re-dissolved in water. To this solution potassium sulphocyanide was added, and a deep red colouration was immediately obtained. Taking a concentrated hot solution of davyum chloride and mixing it with the above-mentioned reagent a red precipitate is obtained, which, on being dried over sulphuric acid, yields beautiful crystals of davyum sulphocyanide; if the same compound is dried quickly on a sand-bath a blackish mass is obtained, being the same salt, davyum sulphocyanide, as analyses showed. These reactions show that the davyum sulphocyanide may be obtained in two forms.

The davyum chloride was more closely examined. This salt is very soluble in water, alcohol, and ether. The carefully crystallised davyum chloride attracts moisture very difficultly; even after a long contact with the air it does not liquefy. On being heated on a gas blowpipe it yields the monoxide, which is soluble only in aqua regia. As platinum chloride, the correspondent salt of davyum with chlorides of potassium, thallium, and ammonium, yields double salts of a dark red colour insoluble in water and easily soluble in absolute alcohol. The double salt of sodium and davyum chlorides is nearly insoluble in water and alcohol, as the following table shows:—

	In 100 parts of—	
	Alcohol.	Water.
0°	0.05	0.09
20	0.08	0.11
40	0.10	0.14
70	0.07	0.10
100	0.06	0.08

This fact is very characteristic, as most of the sodium double salts of the metals of the platinum group are very soluble in water. Davyum chloride is supposed to be the only stable compound of chlorine and davyum, because on being carefully prepared the nearly neutral solution of davyum chloride, evaporated on a sand-bath, liberates abundant vapours of chlorine, so that I think that the second chloride may exist only in solution as the palladium chloride ( $\text{PdCl}_4$ ).

Davyum sulphate is obtained by leaving davyum for a couple of hours in contact with boiling sulphuric acid. The salt is of a yellowish red colour and is nearly insoluble in water.

I made several new experiments on the specific gravity of the metallic davyum. The following are the results obtained. The temperature during the experiments was 24° C.

9.388  
9.387  
9.392

These numbers confirm my late experiments on the same subject very closely. The specific gravity then obtained was 9.385 at 25° C.

My friend, Engineer Alexejeff, is engaged in the determination of the atomic weight of the new metal. Some preliminary experiments show that the atomic weight is not 100 as it was first mentioned, but must be near to 154. The platinum ores contain not more than 0.045 to 0.035 per cent of davyum. Unfortunately the quantity of metallic davyum in hand is so small that it is impossible to commence serious experiments until new quantities of davyum can be liberated from the ores.

Obouchoff Steel Works.

## ACTION OF SULPHUR AT HIGH TEMPERATURES UPON NORMAL PARAFFINS.

By S. CABOT, Jun.

HOPING to obtain a sulphur compound of the normal paraffins which might be decomposed with oxide of lead to an oxide, and perhaps be of use in the candle industry, I took for an experiment some pure heptane,  $\text{C}_7\text{H}_{16}$ , prepared by Prof. Schorlemmer, of Manchester, from petroleum. This was heated in a flask with a large excess of sulphur. The flask was connected with a return tube cooled with water, to prevent the heptane from distilling off and being lost. After five or six hours' heating this mass began to change in colour, and volumes of sulphuretted hydrogen were given off. By continuing the heating the paraffin was almost entirely decomposed. The remainder was examined and proved to contain no organic sulphur compound. The smell was very offensive, but not more so than the combined perfume of  $\text{H}_2\text{S}$  and heptane (petroleum spirit) would produce. The excess of  $\text{C}_7\text{H}_{16}$  was distilled off, and the solid residue was examined by dissolving the sulphur with bisulphide of carbon, which left a black powdery precipitate of carbon. Another portion was heated in a small retort until all the sulphur was distilled off; a black pulverulent residue of carbon was left.

From this experiment it is seen that sulphur at high temperatures decomposes heptane, forming  $\text{H}_2\text{S}$  and carbon. This, I have no question, is the case with all the other members of the group, and I therefore shall not attempt the formation of a sulphur compound of the heavier and solid paraffins.—*American Chemist.*

## CHLORIDE OF COBALT-AMMONIUM.

By J. M. MERRICK, B.Sc.

I FIND that if a solution of chloride of cobalt and one of chloride of ammonium be mixed and set aside for some weeks to crystallise, a confused mass of crystals is obtained. The mass consists of chloride of ammonium (coloured purplish by the cobalt), and in this are imbedded large handsome crystals of chloride of cobalt. These crystals, when picked out and washed, give upon testing only mere traces of ammonia, no more than may reasonably be supposed to be mechanically included in the interstices of the crystal. No double salt appears to be formed in this way.—*American Chemist*.

## SCHœNBEIN'S TEST FOR NITRATES.

By F. H. STORER,

Professor of Agricultural Chemistry in Harvard University.

IN his important paper on the "Behaviour of Ozone towards Water and Nitrogen," Carius\* remarks incidentally that he has not found the iodo-starch test for nitrates (employed in conjunction with zinc, as the reducing agent) a specially delicate one.

It is obvious that this test for nitrates cannot in the nature of things compare in delicacy with the similar test for nitrites, where the iodo-starch is added directly to the suspected liquid, after mere acidulation. A much smaller quantity of nitrite than of nitrate can always be detected by the above-mentioned test, since the zinc, or other reducing agent, which is made to act upon the nitrate in order that the iodo-starch reaction may occur, does not in any case change the whole of the nitrate into a nitrite and no other nitrogenous product. The zinc may fail, upon the one hand, to reduce the whole of the nitrate, while upon the other its action may go too far, so that a part of the nitrite, formed at first, through reduction of the nitrate, may be reduced in its turn and removed from the field of action. Some of the nitrate is always changed, withal, to an ammonium salt, and so destroyed in so far as the power of reacting upon iodo-starch is concerned.

These considerations have often been urged, and they are undoubtedly familiar to most chemists. But in the lack of a better, the iodo-starch test for nitrates has come into very general use, and has been held in high estimation. The remark of Carius must have struck scores of chemists, as it did myself, as extraordinary and hardly credible. It was neither consistent with Schœnbein's statement as to the delicacy of the test nor with the reputation which the test had acquired. I have thus been led to examine the matter somewhat attentively, and to subject the test anew to critical study. It appears from this examination that the lack of delicacy observed by Carius was due to the kind of manipulation employed by him, and that while his statement is doubtless literally correct, it fails to convey a just idea of the much higher degree of delicacy which is readily obtainable by applying the test in a somewhat different way.

Two methods of using the test were described by Schœnbein,† viz.: 1st, To add dilute sulphuric acid and iodo-starch paste directly to the nitrate solution and to stir the mixture with a zinc rod; or, 2nd, and better, as we must infer from Schœnbein's statement, to reduce the neutral solution of the nitrate in the first place by means of zinc or cadmium, thereafter to acidulate it with dilute sulphuric acid, and finally to add the iodo-starch paste. Both of these modifications have come into general use, but the second has been applied, perhaps, even more frequently than the first in cases where very small amounts

of nitrates were to be sought for. It is, in fact, more delicate than the first method. Carius, however, in the experiments above referred to, employed the first modification and not the second.

For my own part, I find that the chief objection to the iodo-starch test for nitrates is by no means a lack of delicacy. The fatal defect of the test, as hitherto applied, is to be found in the fact that mere water, which is absolutely free from any contamination of nitrates or nitrites, on being treated with zinc or cadmium, as if to test it for a nitrate, will react upon iodo-starch precisely as if a trace of some nitrate had been dissolved in the water.

The explanation of this behaviour is not far to seek. The colouration of the iodo-starch is caused by peroxide of hydrogen which has been formed in the water by the action of the metal, according to the familiar experiment of Schœnbein,\* in which peroxide of hydrogen is prepared by shaking zinc-amalgam in water and air.†

The amount of peroxide of hydrogen that is formed in the limited volume of liquid used, and under the conditions which ordinarily obtain when testing for a nitrate, is undoubtedly very small, but it is nevertheless sufficient to give a perfectly distinct reaction with acidulated iodo-zinc starch solution. This reaction is far too strong to admit of its being neglected, subtracted, or allowed for, when searching for traces of nitrates. Hence it happens that in highly dilute solutions of nitrate of potash it is impossible to detect the nitrate by means of iodo-starch as ordinarily applied, not because the products of the reduction of the nitrate by zinc, or the like, cease to act upon the iodo-starch, but because the reaction produced by these products is identical with that of the peroxide of hydrogen that is formed simultaneously with them, and which would be formed just as well in pure water totally devoid of nitrates.

Whenever the degree of colouration of the iodo-starch obtained in testing for a nitrate according to Schœnbein's method, is less intense than the tint obtainable from 0.0001 gm.  $N_2O_5$  (= 0.000187 gm.  $KNO_3$ ) in 50 c.c. water it is difficult to decide whether the colouration may not be wholly due to peroxide of hydrogen. It is easy, at all events, to obtain as much peroxide of hydrogen by boiling cadmium, zinc, or amalgamated zinc with mere water, as will give a reaction with acidulated iodo-zinc starch equal to that obtainable from 0.00005 gm.  $N_2O_5$ , or perhaps even more. The following experiments will illustrate this point:—

A. To 50 c.c. of pure water 0.00005 gm.  $N_2O_5$  (in the form of 0.0000936 gm. of nitrate of potash) was added; the mixture was boiled five minutes with a piece of cadmium in a small flask, then cooled, transferred to a porcelain capsule, acidulated and tested with iodo-zinc starch.

B. The same experiment was repeated with pure water to which no nitrate had been added.

C. Same as A, with the exception that zinc was used instead of cadmium.

D. Same as B, with the exception that zinc was used instead of cadmium.

The four capsules were placed side by side under a darkened bell glass, and left to stand over night. On examination it appeared that while the contents of capsules B, C, and D seemed to be of one and the same depth of colour, the contents of capsule A were distinctly lighter coloured than those of either of the other dishes. These experiments were simultaneous, and care was taken that they should be strictly comparable one with another. Each experiment was conducted as if a nitrate were being tested for. Equal surfaces of metal, as nearly

\* Poggendorff's *Annalen*, 1861, cxii., 288.

† Schœnbein has himself shown (*Journal für prakt. Chemie*, 1861, lxxxiv., 206) that peroxide of hydrogen is formed simultaneously with a nitrite, when the aqueous solution of a nitrate is treated with zinc or cadmium, as a preliminary to the application of the iodo-starch test, but he seems to have completely overlooked the fact that the presence of the peroxide would preclude the application of his test for nitrites, in cases where the solution to be examined contained only a small quantity of the nitrate.

\* *Annalen der Chemie*, 1874, clxxiv., 14, note.

† See, for example, his paper in Fresenius's *Zeitschrift Analyt. Chemie*, 1862, i., pp. 14, 15.

as might be, were exposed to the action of the liquids in each instance.

Repetitions of these tests gave similar or analogous results. Sometimes the contents of one capsule in the series would be more or less strongly coloured than the rest, and at other times another; but everything went to show that by this method of testing traces of nitrate cannot be distinguished from the peroxide of hydrogen that is naturally formed in the liquid under examination. So, too, when amalgamated zinc was used instead of the simple zinc or cadmium. It is true, as Schœnbein\* has said, that water which contains only  $\frac{1}{100000}$  of nitrate of potash will colour iodo-starch blue, after having been shaken or boiled with bits of amalgamated zinc, filtered, and acidulated with sulphuric acid; but since water that is absolutely free from nitrates will do almost precisely the same thing when similarly treated, the statement is of no value either as regards the delicacy of the test or the limit of its applicability.

Proof that the cause of the reaction in the water free from nitrates is really due to the presence of peroxide of hydrogen is readily obtained on testing the neutral liquid for that substance with a drop or two of a weak solution of ferrous sulphate† and the solution of iodo-zinc starch. The characteristic blue colouration of the iodo-starch will quickly appear when pure water that has been boiled with cadmium or with zinc has been subjected to this test, while no reaction is obtained, even after the lapse of many hours, when pure water that has not been in contact with a metal is similarly treated.

With pure water these results are constant and invariable, but it is noteworthy that, on testing in this way, samples of water taken from wells, and of rain water taken respectively from a brick and from a leaden cistern, no reaction for peroxide of hydrogen was obtained after simple boiling for five minutes with the cadmium, though on boiling with cadmium and then leaving the liquid to stand upon the metal for twenty-four hours a reaction for the peroxide was finally obtained with the rain water. So, too, when the pure water was tested in a somewhat different way by mixing it directly with the solutions of iodo-zinc starch and sulphate of iron and ammonia, and placing a piece of cadmium in the mixture, the blue colouration soon appeared, while no such colouration was observed when samples of rain or well water were tested in this way; far from becoming blue, the liquids soon acquired a rusty colour, as if from oxidation of the iron salt.

Care was taken to control the peroxide reactions by applying the test (ammonium-ferrous sulphate and iodo-zinc starch) to acidulated water that had not been in contact with cadmium or zinc, to acidulated and to neutral solutions of pure nitrate of potash, to neutral solutions of nitrite of soda, all made with pure water, and to the distillate from a solution of nitrite of soda that had been boiled with dilute sulphuric acid. But no trace of blue colouration was observed in either instance.

Corroborative evidence of the presence of peroxide of hydrogen in the water that had been boiled with cadmium was obtained as follows:—Two portions, each of 100 c.c., of pure water were taken. To one portion two-hundredths of a milligramme of nitrous acid was added, in the form of nitrite of soda, together with 2 c.c. of dilute sulphuric acid (1:4), and the mixture was boiled for ten minutes in order to expel the nitrous acid. The other portion was boiled with cadmium, as if it were to be tested for a nitrate, the cadmium was removed, the liquid was mixed with 2 c.c. of the dilute acid, and then boiled for ten minutes. Each portion was finally tested, when cold, with iodo-zinc starch. The second portion, viz., the one to which no nitrate had been added, speedily gave a

reaction, but the first portion did not. After standing twelve hours in the dark, the first portion remained colourless, while the second portion was distinctly blue. In a word, the nitrous acid known to have been present in the first portion had been completely expelled by the boiling, while much of the peroxide of hydrogen in the second portion had remained intact.

The fact that highly dilute aqueous solutions of peroxide of hydrogen suffer but little decomposition at the temperature of boiling has often been insisted upon;\* but less attention seems to have been paid to the equally important fact† that some of the peroxide goes forward, as such, with the vapour of water, and may be detected in the distillate. This volatility of the peroxide is a point of no little significance for the analyst, since it makes it much more difficult than would otherwise be the case to detect traces of nitrites in solutions suspected to contain them, as well as the peroxide. Contrary to the opinion expressed by Plugg,‡ it would be altogether useless, in delicate experiments, to apply, in the presence of peroxide of hydrogen, that method of testing for nitrites which depends upon the volatility of nitrous acid, viz., the distillation of the nitrite solution with a dilute acid and subsequent testing, with iodo-starch plus acid, for nitrous acid in the distillate. The following experiments will illustrate the importance of this consideration:—Two portions of pure water, each of 250 c.c., were taken, and one was distilled directly with acetic acid, while the other was boiled with cadmium for five minutes, and thereafter distilled with acetic acid, pains being taken to make the two experiments alike in all other respects. The first 50 c.c. of distillate were collected in each instance, and tested with iodo-zinc starch after acidulation. No reaction was obtained in the distillate from the mere water and acetic acid, while the distillate from the water that had been boiled upon cadmium became coloured in less than half an hour. Repetitions of this experiment gave similar results.

That only a part of the peroxide goes forward with the steam will be seen from the following trials:—Two separate 250 c.c. portions of pure water that had just been distilled off from a flask containing a mixture of zinc and spongy copper were boiled with cadmium, and a part of each of the liquids was tested directly with iodo-zinc starch plus acid, while the remainders were distilled with acetic acid, and the first 50 c.c. of distillate was subjected to the test in each instance. In both trials the portions tested directly gave a stronger colouration than was obtained in either of the distillates. In order to be sure that the acetic acid had no improper influence on these reactions, several portions of pure water were distilled with the acetic acid for a time, a fresh portion of the acetic acid was then added, and the next 50 c.c. of distillate was tested with iodo-zinc starch plus acid, but no reactions were obtained, although the mixtures were allowed to stand twenty-four hours after the application of the test.

It may be mentioned in this connection that the tendency of peroxide of hydrogen to be transported with the vapour of water may perhaps afford the true explanation of the cause of the presence of the peroxide in some of the solutions examined by Meissner in his "Untersuchungen über Sauerstoff, Hannover," 1863, pp. 94—110. Such transportation of the peroxide may account, moreover, for the presence of this substance in the outer or water tube of Schœnbein's and Meissner's (op. cit., p. 74) earlier experiments on the making of peroxide of hydrogen from peroxide of barium and sulphuric acid, without need of supposing that the "antozone" of these chemists had any part in the reaction.

With regard to the delicacy of the iodo-starch test for nitrates, supposing there were no interference from peroxide of hydrogen, it appears, as has been stated above,

\* *Zeitschrift Analyt. Chemie*, 1862, i., 15.

† Or, instead of simple ferrous sulphate, the double sulphate of protoxide of iron and ammonia may be used with advantage, as was suggested by Struve, Fresenius's *Zeitschrift Analyt. Chemie*, 1869, viii., 319. Most of the tests described in the text were made with this double salt. Two or three drops of a 1-100 normal solution of it were ordinarily used.

\*\* Compare Gmelin—Kraut's "Handbuch der Chemie, 1872, i. (2te Abth.), p. 58.

‡ First recognised, I believe, by Schœnbein. See Will's *Jahresbericht*, 1866, p. 105.

† Fresenius's *Zeitschrift Analyt. Chemie*, 1875, xiv., 141.

that that method of procedure in which the nitrate is reduced by itself, as a separate, preliminary step, before the acidulation of the liquor or the addition of the iodo-starch, is decidedly preferable to the other system of adding the iodo-starch, the acid, and the reducing agent all at once to the nitrate solution. As Goppelsrœder\* has remarked, it seems to be immaterial whether the nitrate solution be boiled for a few moments with the cadmium or zinc, or left to stand for some hours in the cold in contact with one of these metals; though the boiling will usually be found more convenient in practice.

It has been customary hitherto, in this laboratory, to proceed as follows, when testing for nitrates by Schœnbein's process:—100 c.c. of the suspected liquid were put in a small glass flask, together with bits of metallic cadmium and boiled for five minutes. When the liquid had become cold, half of it was transferred to a small porcelain dish, 1 c.c. of dilute sulphuric acid† was added to it, and finally 2 c.c. of iodo-zinc starch solution.‡ The capsule, with its contents, was then placed under a darkened bell-glass and examined at stated intervals. Tested in this way, a solution of nitrate of potash, containing 0.0005 grm.  $N_2O_5$  in 50 c.c. water, gave an immediate colouration on being mixed with iodo-zinc starch plus acid, after having been boiled for five minutes upon cadmium; with a solution containing 0.0002 grm.  $N_2O_5$  the blue colouration appeared about five minutes after the addition of the iodo-starch, and with a solution containing 0.0001 grm.  $N_2O_5$  the colour began to appear in about eight minutes. The last-named quantity indicates very nearly the limit of applicability of the test, since the degree of colouration derivable from an amount of the nitrate any smaller than this could hardly be distinguished from that due to the peroxide of hydrogen that is obtained on boiling pure water upon cadmium or zinc. It is true that the colouration

caused by the products of the reduction of a nitrate generally appears rather more speedily than the colouration produced by peroxide of hydrogen, but since the reaction of the peroxide often begins to show ten or fifteen minutes after the addition of the iodo-zinc starch and acid, and sometimes even sooner, no dependence can be placed upon mere rapidity in the appearance of the colouration as a means of distinguishing the nitrate from the peroxide. In case the mixtures are left to stand over night, or for a number of hours, after the iodo-starch has been added, this seeming advantage in favour of the nitrate solutions disappears; for (after long standing, the colouration due to peroxide of hydrogen is often as deep as that obtained from 0.00005 grm.  $N_2O_5$ , and the difference between this tint and that obtained from 0.0001 is by no means large enough to permit of distinguishing the one from the other with any certainty.

Results very different from the foregoing were obtained when 50 c.c. of the pure nitrate solution, mixed directly with 2 drops of the dilute acid and 2 c.c. of the iodo-zinc starch solution, were left to stand in contact with a rod of zinc, according to the method employed by Carius.\* On proceeding in this way, a solution containing 0.01 grm. of  $N_2O_5$  (=0.01872 grm.  $KNO_3$ ), in 50 c.c. of water gave a reaction almost immediately when the zinc was added; and a solution containing 0.005 grm.  $N_2O_5$  (=0.00936 grm.  $KNO_3$ ) began to show a blue colouration at the lower end of the zinc rod in a few minutes, while in a solution containing 0.002 grm.  $N_2O_5$  (=0.00374 grm.  $KNO_3$ ) no colouration could be perceived even after the lapse of two hours, though the liquid was examined at frequent intervals. On repeating this trial with 0.002 grm.  $N_2O_5$  a similar result was obtained. 0.003 grm.  $N_2O_5$  (=0.005616 grm.  $KNO_3$ ) in 50 c.c. water gave a very slight colouration at the lower end of the zinc rod after a comparatively short time. Trials similar to the above, in which amalgamated zinc was used instead of simple zinc, gave no better results, but rather worse, on the whole. Rods of cadmium appeared to be somewhat preferable to those of zinc, though not much.

It will be observed that the results of these tests are even less favourable than those obtained by Carius, since this chemist puts the limit of delicacy at 0.0015 grm.  $KNO_3$  in 50 c.c. water. The following experiments, moreover, go to show that when the test is used in this manner the presence of trifling impurities in the solution to be examined may interfere with the reaction very decidedly and render the negative indications of the test untrustworthy even at the comparatively low degree of delicacy above mentioned. Thus, on repeating some of the foregoing trials and using rain-water to dissolve the nitrate, instead of the pure water previously used (see foot-note) less favourable results were obtained. A solution of the nitrate equal to 0.005 grm.  $N_2O_5$ , in 50 c.c. cistern water gave no reaction with the iodo-zinc-starch in the course of an hour. On repeating the trial with cistern-water that had just been boiled, a slight reaction was obtained, but the blue colour instead of increasing faded away after a time and disappeared. The proportion of acid employed to acidulate the mixture is not without influence upon the delicacy of the test, and it may well be that in order to obtain the best results a larger amount of acid is required than was used in the foregoing trials. The small quantity of the acid actually taken was chosen in order to conform to Carius's injunction that "the addition of but little acid is a condition of success." But it appeared once on repeating the trial with the nitrate solution, in pure water, that contained 0.005 grm.  $N_2O_5$  in 50 c.c., that while no colouration of the iodo-starch had appeared after some time so long as only two drops of sulphuric acid had been added, the reaction soon set in on the addition of two more drops of the acid.

(To be continued.)

\* Poggendorff's *Annalen*, 1862, cxv., 128.

† The dilute sulphuric acid is prepared by mixing one volume of oil of vitriol with three volumes of pure water, boiling the mixture for an hour, and finally adding enough pure water to replace that which has evaporated.

‡ The solution of iodo-zinc-starch is prepared as follows, after Kubel-Tiemann, "Anleitung zur Untersuchung von Wasser," Braunschweig, 1874, p. 140: Rub 4 grms. of starch in a porcelain mortar with a little water, and pour the smooth, milky liquid, little by little, into a boiling solution of 20 grms. pure commercial chloride of zinc in 100 c.c. of distilled water. Continue to boil the mixture until as much of the starch as possible has dissolved, and the liquid has become almost clear, taking care meanwhile to replace the water that evaporates. Dilute with distilled water; add 2 grms. of pure, dry, commercial iodide of zinc; bring the volume of the liquid to a litre, and pour it into a tall cylinder to settle. After several days, decant the clear liquid and keep it in the dark in well-closed bottles.

Pure water is obtained as follows: Enough crystallised permanganate of potash is dissolved in rain-water to colour the liquid strongly; the mixture is left to stand for twenty-four hours, and then transferred to a copper still. A lump of lime is added and the mixture is distilled slowly, the first fractions of distillate being rejected. The rest of the distillate is re-distilled in a glass flask, upon lime, and the new distillate is rejected until it ceases to show ammonia when tested with Nessler's reagent. Such water is free from ammonia and from nitrates, and when tested for nitrites with iodo-zinc-starch, plus acid, it will not show any trace of colouration at the end of an hour, and will seldom show any appreciable tinge of colour when the mixture is left to stand over night, though on standing for twenty-four hours a faint shade of colour will usually appear. I have commonly attributed this tendency to give a reaction to the presence of an infinitesimal trace of nitrite, but it is not impossible that it may be due to peroxide of hydrogen that has been formed by means of the copper of the still. It would undoubtedly be better, when possible, to perform all the distillations in glass vessels. However that may be, such water is abundantly pure enough for the purposes of this research. For cases where absolute purity is essential, water that will not give any reaction for nitrites may be prepared, by acidulating with acid sulphate of soda the pure water obtained as above (from glass vessels) and re-distilling it in a glass flask. Free nitrous acid being readily volatile will go forward in the first portions of distillate from the acidulated water, so that, by rejecting a considerable fraction of the distillate at first and saving the water that comes over later, it is no very difficult matter to obtain water that is perfectly free from all three of the nitrogen compounds now in question as well as from peroxide of hydrogen.

Most well-waters, it should be said, are, if anything, rather better than rain-water for preparing a pure product.

By making the mixture of permanganate and water alkaline with lime instead of a caustic alkali, the nitrous compounds which almost always contaminate the latter are avoided.

## NOTICES OF BOOKS.

*Eleventh Annual Report of the Warden of the Standards on the Proceedings and Business of the Standard Weights and Measures Department of the Board of Trade for 1876-7.* London: G. E. Eyre and W. Spottiswoode.

It appears that standard "gas-measures" have been supplied to the Lord Mayors of London and Dublin and to the Lord Provost of Edinburgh as far back as 1860. But unfortunately "The Sale of Gas Act" makes no provision for the use of these models, and it is a matter of regret that such instruments should have been sent to these cities without some instructions as to their use. In the same cities the working standard gas-measures used by the inspectors in the actual testing of gas-meters have not been verified for seventeen years. Hence, as the report very justly remarks, "the accuracy of any results obtained from them is doubtful." It appears further, that the inspector of gas-meters is not required by law to examine into the accuracy of the index. Yet after such a partial examination the instrument is stamped as correct! "Three recent instances have been reported to this department in which consumers of gas were charged for gas much in excess of what they had consumed owing, as it was subsequent accidentally discovered, to the inaccuracy of the index only. In one instance a 'three-light' meter registered five times more than was really consumed; in a second instance a '300-light' meter registered three times more than was actually consumed; and in a third instance, Mr. W. B. Davis, of Torquay, complains that his meter, though stamped as correct, had been found to register 86,000 feet in excess." It is surely time that some more efficient and trustworthy method of measuring gas should be devised. Had the defects of the present meter told against the vendor we will venture to say that it would have been long ago discontinued.

In another portion of the report the "rude and antiquated method of teaching weights and measures" still pursued in schools is justly complained of. It appears that in arithmetical treatises children are still taught weights and measures which are illegal and obsolete. But a still greater misfortune is that a number of such illegal weights are still used in actual business, and that a person removing from one part of England to another finds himself a complete stranger to the standards of the locality, and has often to pay dearly for instruction. Would it be much harder to learn once for all the metric system?

*Elementary Chemistry: a Text-Book for Beginners, Designed as an Introduction to Barker's Chemistry.* By S. F. PECKHAM, A.M., Professor of Chemistry, University of Minnesota. Louisville: J. P. Morton and Co.

THIS is an elementary treatise on chemistry drawn up in the form of a series of dialogues between a certain Uncle Louis and his nephews and nieces, who are supposed to be desirous of turning their vacations to account by the acquisition of knowledge not included in the school curriculum. The bulk of the matter, as might be expected, is neither better nor worse than what may be found in others of the scarcely numerable introductory works on chemistry which have appeared in America and in England. The descriptions are clear and the experiments are simple, easy of performance, and well calculated to illustrate the main truths of the science.

The chapter on dyeing and calico-printing, however, contains certain passages to which exception may fairly be taken. Thus, the reader is informed that the difference between "fast" and "loose" colours is that the former are deposited inside the tubes of the fibre, whilst the loose colours are merely stuck on outside. The distinction is therefore made to appear as depending, not on the

nature of the colours themselves, but on the method of their application. This is a serious error. In the first place not all fibres are tubular. Secondly, the distinction between fast and loose colours is one of degree, not of kind. Lastly, if we take a fast and a fugitive colour, say indigo and carthamine, and expose them both to the sun under precisely similar circumstances, and without the intervention of any fibre at all, we shall find the former remains unchanged, whilst the latter quickly fades. We certainly should not select the so-called pigment style of calico-printing—the fixation of insoluble colours by means of albumen, &c., as a characteristic example of "loose colours." Nor can we subscribe to the statement that "almost all muslin de laine is printed with albumen." We do not, however, wish it to be understood that all the sections treating of the applications of chemistry to the arts and manufactures are equally impaired with inaccuracies.

*The Metallurgical Review.* Published Monthly by DAVID WILLIAMS, 83, Reade Street, New York. No. 1, September, 1877.

THIS is a notable specimen of American literary enterprise, a magazine of 100 pages, admirably printed on superior paper, and with illustrations. It contains essays on the following subjects:—"The Mechanical Treatment of Metals," by Prof. R. H. Thurston; "New Iron District of Ohio," by E. C. Pechin; "Analyses of Bessemer Steels;" "Siphon Tap in Lead Smelting," by C. Kirchhoff, Jun.; "Danks's Furnace at the Millvale Works," by John J. Williams; "Blast-Furnace Fumes;" "Cinder in Puddled Iron;" "On Steel," by William Metcalf, C.E.; "Stopping-up of Regenerators in the Siemens Furnace;" "Studies of Elemental Iron in its Modifications," by Prof. Henry Wurtz;" "Iron Making in New South Wales;" "Chlorine Compound in the Blast-Furnace;" "Protecting the Lining of Blast-Furnaces," by J. D. Weeks; "Silicon in Bessemer Pig;" "Reduction of Ores in the Bessemer Converter;" "Use of Alloys of Silicon and Manganese in Casting Steel," by Sergius Kern; "Nails from Old Rails;" "A New Metal;" "Determination of Phosphorus in Iron, Steel, and Ores," by A. J. Preusse; "Mixtures for Tempering Small Steel Articles;" "Novel Joint Stock Company."

Our space does not permit special criticism of any of the above articles. Those we have read are carefully written in a philosophic spirit that is well suited to a magazine of the high pretensions of this review. There is an absence of the trade advertisement class of articles that commonly abound in technological journals. The nearest approach to these is the article on the Danks's furnace by the superintendent of the Millvale Works. This, although a vigorous vindication of a special device, is free from any efforts at puffing, and perfectly fair and legitimate in its partizanship.

The fact that such a magazine as this can be launched in the United States with prospect of success indicates a degree of technological intelligence and activity on that side of the Atlantic which is well worthy of the serious attention of our own iron masters and other practical metallurgists. It is one among other signs of the times that may serve as a warning to those who imagine that "the rule-of-thumb" will continue to enable us to retain our manufacturing supremacy in the contest with our Transatlantic cousins, whose supplies of raw material, coal, and ores are so much greater than our own, and who, in addition to this, appear to be passing us in the all-important effort to bring the great discoveries of modern science to bear upon the development of industrial operations.

The publishers of this review evidently aim at a circulation extending beyond the limits of the United States, as the subscription price of five dollars per annum includes domestic or foreign postage. They announce that "the indexing of the volumes will be very complete,"

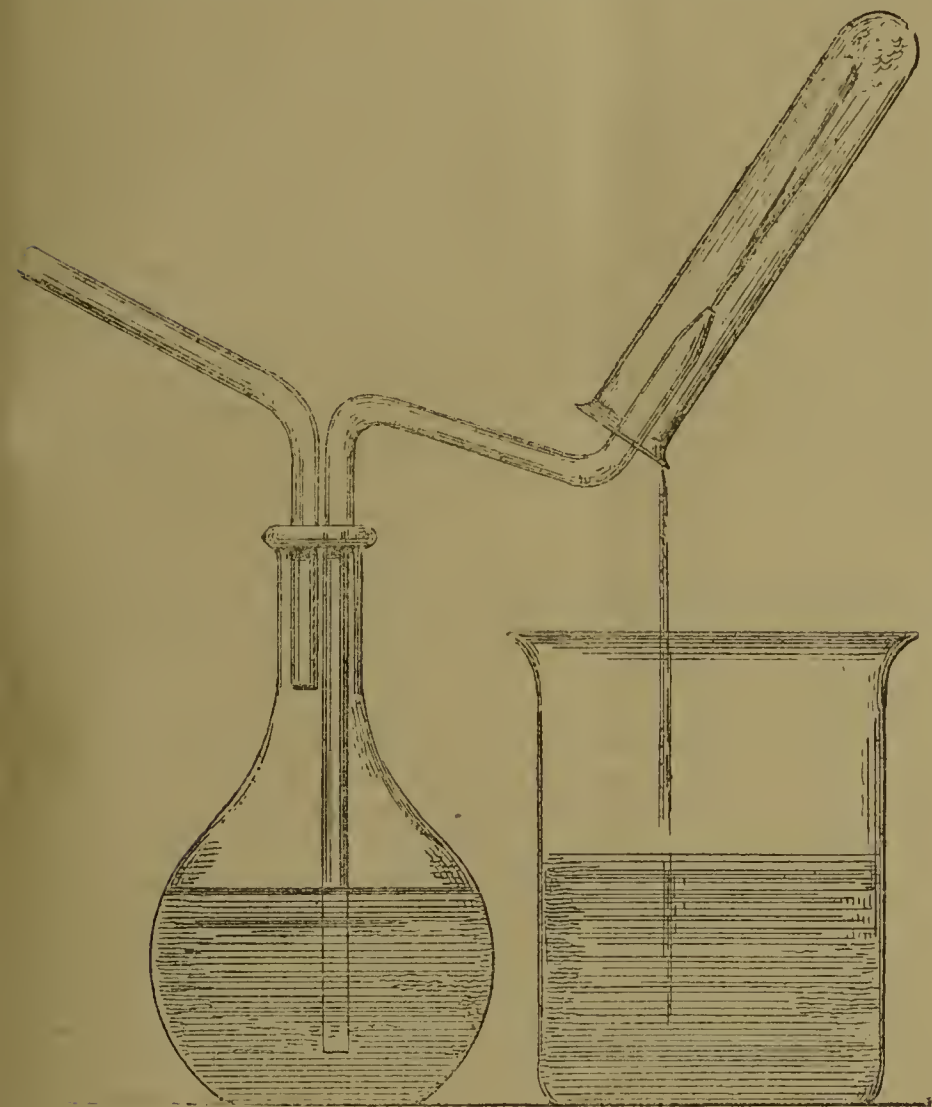
also that "each number will be printed from *electrotype plates*, and orders for back numbers or complete sets from the beginning can always be fulfilled."

## CORRESPONDENCE.

### IMPROVED WASH-BOTTLE.

To the Editor of the Chemical News.

SIR,—Noticing an article on "Simple Laboratory Manipulations" in the CHEMICAL NEWS (vol. xxxvi., p. 57), I thought I would enclose you a sketch of a form of wash-bottle which I have found extremely useful in washing precipitates, &c., from test-tubes, beakers, &c. The improvement consists simply in bending up the jet end of the



tube at about an inch and a half from the extremity; so that while the bottle is held in the ordinary upright position a vertical jet of water can be directed into a test-tube inverted over a beaker to receive the washings, as shown in the sketch.—I am, &c.

E. H. JOHNSON.

New York, August 22, 1877.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 8, Aug. 20, 1877.

Characters of Flames charged with Saline Dust.—M. Gouy.—Flames produced by a detonating mixture of coal-gas and of air charged with saline dust are dis-

tinguished by several characteristics from the coloured flames ordinarily observed in spectral analysis. (1.) Certain salts, such as copper and calcium chlorides, &c., which commonly give rays proper to the undecomposed salt, show here nothing similar and are entirely dissociated; thus calcium nitrate and chloride and copper nitrate and chloride give respectively the same spectrum. In case of the latter metal the spectrum of the chloride reappears if the flame is charged with hydrochloric acid, or if it is cooled by any means soever. Thus the reducing flame burning in a current of coal-gas is surrounded with a blue envelope, which shows the bands of the chloride; in like manner, if the flame contains a large excess of air, its point is coloured a pure blue, and gives exclusively the spectrum of the chloride. A cold body—as, e.g., a glass rod—if introduced into the flame is surrounded with a blue halo which displays the bands of the chloride. If this spectrum is seen when operating in the ordinary manner it is due to the cooling produced by the platinum wire. Strontium, and especially barium chloride, are not entirely dissociated under similar circumstances. The same method is suitable for the study of the spectra produced by oxidising or reducing flames. It is merely requisite to charge the mixture with an excess of air, or to cause the reducing flame to burn in a current of coal-gas. The detonating mixture is made perfectly homogeneous by causing it to pass through a receiver containing 15 litres. We observe, then, that the spectra of the metals do not disappear suddenly at a certain composition of the gaseous mixture, but become gradually weaker as the excess of air augments. Thus the quantity of the metal which remains free is a continued function of the excess of oxygen in the flame—a function very different for different metals. It is the same with the oxides, at least with the oxide of copper, the only one which gives a beautiful spectrum, and is easily adapted to these experiments. With an excess of air it gives a green flame, whose spectrum is well-known. The flame on being rendered reductive turns reddish; it still shows the same spectrum, but the red bands predominate. Whatever may be the cause of this remarkable change there is no doubt of the existence of oxide of copper in vapour in this flame, which reduces solid oxide of copper. It has been established by M. H. Sainte-Claire Deville that such flames contain free oxygen. These observations show the necessity of operating with flames homogeneous and not cooled in order to obtain definite results which may be of some value in sidereal spectroscopy. We see, for instance, that the absence of the rays of the chlorides in the solar spectrum is not the necessary proof of an excessive temperature. (2.) The author has shown (*Comptes Rendus*, lxxxiv., p. 231) that the surface of the interior cone which forms the base of every homogeneous flame possesses a peculiar emissive power when the detonating mixture holds in suspension saline dust, and gives the same rays as the induction-spark striking upon a solution of the same salt: to the list of metals which display this phenomenon may be added sodium, tin, bismuth, chrome, and osmium. He has studied in detail the structure and the variations of this surface, regulating the flame in such a manner that the height of the cone might differ little from the diameter of its base. When the detonating mixture does not hold saline dust in suspension the surface of the cone gives merely the rays of carbon, and, if the composition of the mixture varies, undergoes great variations of colour, which are generally described in a manner not very exact. When the flame contains neither an excess of air nor of gas, and is at its maximum temperature, the surface is blue; with an excess of air it becomes violet, and its spectrum is almost continuous. With an excess of gas it is at first green, then blue, and less brilliant; this is generally the case with the Bunsen lamp. At the same time it grows dull, its margins become indistinct, and when the flame grows bright at the point it is entirely effaced. A very fine metal wire, supported upon a stronger wire, and introduced into the interior cone, enables us to observe the distribution of

temperature there. We see that when the flame has not a great excess of gas the temperature seems to augment abruptly on the surface of the cone. With a large excess of gas the wire becomes red-hot at a distance of 1 m.m. and more from the surface. Hence if we place in suspension in the combustible mixture pulverised cupric chloride the salt is volatilised before reaching the surface of the cone, throws out rays for a moment, and is then dissociated as the temperature increases. We see then appear a blue surface, equidistant from the former, and between the two a dark space. The new surface is more brilliant than the other, and shows the bands of the chloride; the dark interval may exceed 1 m.m., and diminishes simultaneously with the increase of the gas. With the acetate of copper the surface of the cone becomes rose-coloured, the flame being somewhat reddish. Beneath it is a slender green layer, which appears due to the cupric oxide volatilised in the mixture very hot, but not combined. As for the rose-coloured surface, it has the colour which the oxide of copper takes in a reducing flame. With a great number of other salts, as those of lime, strontia, &c., the surface of the cone if the gas is in excess loses its peculiar colour and takes that of the flame, upon which it forms a light pattern. It is the same with salts such as chloride of cobalt, which gives a white flame full of very small solid particles. The author has given a great lustre to the spectrum of the inner cone by placing twenty small flames in a straight line in the axis of the collimator of the spectroscope. In this manner he has examined the spectrum of platinum chloride. This salt gives at the base of the flame a spectrum of bands not seen when operating in the common manner, and which the spark does not show. This spectrum is formed of sixteen bands, grouped two and two like those of copper chloride, but larger and more remote from each other. Their right margin (on the violet side) is very distinct, and they fade away on the right. Some of them are furrowed with equidistant black rays. We see, also, some fainter nebulous rays in groups of two or three. This spectrum extends from the red to the violet. Some bands, not the strongest, are still visible above the inner cone. This spectrum is due to platinous chloride, which, according to MM. Troost and Hautefeuille, is re-formed at an elevated temperature. All these observations agree in indicating the existence, at the base of the flame, of a very thin stratum where the temperature is much higher than in the flame itself—a result which theory renders probable.

Researches on the Chromates.—M. A. Etard.—Already noticed.

*Justus Liebig's Annalen der Chemie,*  
Band 187, Heft 1 and 2.

Hydrogenisation of Benzol and its Homologues.—F. Wreden.—This paper consists of three chapters, the first on "Hexahydro-isoxylol"; the second on the "Hexahydro Derivatives of Toluol, Benzol, and Cymol"; and the third on the general results of the experiments undertaken. It appears that the benzol hydrocarbons are incapable of taking up more than 6H, and that a direct transition from benzol and its homologues to the homologues of methan with an equal number of carbon atoms in the molecule is impracticable. Hence we must admit the existence of a series of homologous hydrocarbons of the general formula  $C_6H_{12-m}R^m$ , which approximate very closely in their properties to the homologues of methan.

Tetra-hydro-isoxylol, and the Constitution of the Camphoric Acids.—F. Wreden.—The isomeric camphoric acids may be considered as the dicarbon acids of two isomeric iso-carbons, tetra-hydro-iso-xylol and Moitessier's hydrocarbon,  $C_8H_{14}$ . The optically inactive modifications may be regarded as isomeric tetra-hydro-iso-xylol-dicarbonic acids,  $C_6H_8(CH_3)_2(CO_2H)_2$ . The latter as substitutes of hexa-hydrobenzol must approximate in their behaviour to Baeyer's hydro-mellithic acids and to hexa-hydro-phthalic acid.

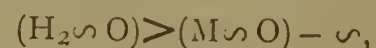
New Organic Acid Occurring in Nature.—C. Stahlschmidt.—The acid in question, the polyphoric, occurs in certain fungi of the family *Polyporus*, growing on the stems of diseased or dead oaks. The empirical formula is  $C_9H_7O_2$ . This acid has a yellow colour, and is so completely insoluble in water that the slightest trace of a soluble polyporate in water renders the liquid turbid on the addition of salt or of soluble sulphuric acid. In virtue of this property the soluble polyporates may serve as indicators in alkalimetry, the turbidity serving instead of the usual change of colour. With all bases it forms well defined salts, of which the soluble ones, those of the alkalis and ammonia, form deep purple solutions. On heating polyporate of potassium to redness in a combustion-tube along with zinc-powder benzol was obtained, which was identified by its conversion into nitro-benzol and thence into aniline.

Communications from the Laboratory of the University of Halle.—These consists of a paper on the "Ammonia Derivatives of Benzo-phenon and Aceton," by M. Pauly, a long and interesting paper, to which justice could not be done in an abstract; a memoir on the "Reducing Action of Bone-black at a Low Temperature," by W. Heintz. In this essay the author states that he was formerly of the opinion that animal charcoal if carefully lixiviated and recently ignited could not precipitate platinic chloride. In the course of certain researches, where he had frequent occasion to act upon platinum double salts with animal charcoal, he became convinced of the contrary, reduction really taking place. He ascribes this action to the hydrogen, which even at the most intense heat cannot be entirely expelled from charcoal. The Halle communications further comprise two papers by the same authors, one on the "Decomposition of Nitroso-triacetonamin by Acids," and one on the "Formation of Phoron from Nitroso-triacetonamin."

Action of Phosphoric Pentachloride upon Anhydrous Tungstic Acid.—Nicolae Teclu.—The compounds resulting from the reaction are tungstic hexachloride and phosphoric oxychloride.

Three Dichlorobenzoic Acids, and certain Derivatives of Trichloro-toluol.—Dr. Richard Schultz.—This memoir is not adapted for useful abstraction.

Affinity of Sulphur and Oxygen for Metals.—Dr. Otto Schumann.—The author remarks that Thomsen has endeavoured to measure the respective affinities of various elements by the amount of heat liberated on their combination. Another method for the determination of affinities has been the investigation whether an element could more or less easily be substituted for another in its compounds. Both these methods are liable to give erroneous results, since physical changes often accompany the chemical action. Thus a part of the matter present may become insoluble or be volatilised, and may thus escape from further participation in the reaction. A second physical influence is the presence of a third body which does not participate in the decomposition, as we find in the so-called action of contact. The formation of sulphide on the action of hydrogen sulphide upon a metallic oxide may arise from two causes—either the affinity of the metal for sulphur may be greater than for oxygen, or the affinity of the hydrogen for oxygen may be greater than for sulphur. The latter case only occurs when the affinity of hydrogen for oxygen is greater than that of the metal for oxygen, consequently when—



being Thomsen's symbol for affinity, or only in case of metals whose oxides are decomposed by hydrogen at elevated temperatures. In case of the metals of the alkalis and alkaline earths, as well as of Mg, Al, Cr, Mn, the formation of a sulphide can never be a direct proof of the greater affinity of sulphur. If watery vapour acts upon a sulphide with formation of oxide we have in this fact a direct proof of the superior affinity of oxygen. The same

conclusion may be legitimately drawn when oxide is formed on the action of hydrogen upon a sulphate. When, however, a sulphide is produced under the same circumstances no direct conclusion can be drawn. The author then gives at some length an abstract of the earlier literature of the subject.

**Hypo-phosphoric Acid.**—T. Salzer.—An investigation in detail on the formation, properties, and combinations of hypo-phosphoric acid. The author assigns to the hypothetical anhydrous acid the formula  $\text{PO}_4$  and to the hydrate  $\text{PO}_4 \cdot 2\text{HO}$ .

**Modification of the Method of Dumas for the Determination of Vapour Densities.**—J. Habermann.—This paper requires the accompanying engraving.

**Communications from the Chemical Laboratory of the University of Greifswald.**—These communications consist of a paper on para-dibrom-sulpho-benzolic acid, by Dr. H. Borns.

*Beiblatter zu den Annalen der Physik und Chemie,*  
No. 1, 1877, Band 1, stück 1.

**Observations on the Deviation of the Lines in the Solar Spectrum.**—C. A. Young (*Sillim. Journ.*, xii., 321).—The author infers from his experiments that the sun revolves at the rate of 1.42 miles per second, whilst direct observation gives only 1.2. This difference Young explains by the hypothesis that the body of the sun has a distinct movement within the chromosphere.

**Experimental Investigations on the Magnetic Rotation of the Plane of Polarisation.** (III. Dispersion of Planes of Polarisation in Case of Rays of Different Wave-Lengths.)—H. Becquerel.—Taken from *Comptes Rendus*, lxxxiii., p. 125, 1876.

**Observation of the Ultra-red Portion of the Spectrum with the Aid of Phosphorescent Phenomena.**—E. Becquerel.—From *Comptes Rendus*, lxxxiii., 251.

**Efflux of Mercury from Capillary Tubes of Glass.**—F. Villari (*Cim.* xv., 263, and xvi., 23).—The mercury may escape either in drops or in a stream. Poiseuille's law applies in the former case but not in the latter. (See *Pogg. Ann.*, cxi., 367.) The coefficient of friction assumes different values according to the manner in which the capillary tubes have been cleaned.

**Action of a Moving Dielectric upon an Electric.**—B. Felici (*Cim.*, xv., 73).—Beneath a plate of aluminium suspended horizontally from a long thin silver wire a horizontal glass plate was caused to revolve. As long as the aluminium plate was not electric it followed the glass plate but slightly, in consequence of the friction of the air. As soon as it is electrified it revolves twice or thrice on its axis in the direction of the revolution of the glass disc.

**Electro-chemical Researches on the Benzol Derivatives.**—F. Goppelsroeder (*Bull. de la Soc. de Mulhouse*, 1876, May 11, and *Comptes Rendus*, lxxxi., 944, 1875; and lxxxii., 1199, 1876).—Already noticed.

**Thermo-electric Properties of Sodium and Potassium at Different Temperatures.**—A. Naccari and M. Bellati (*Atti del Inst. Ven.*, ii.).—Not suitable for abstraction.

**Action of a Copper Zinc Element upon Chlorates and Perchlorates.**—Mr. Eccles.—Taken from the *Journ. of the Chem. Soc.*, clii., 856, 1876.

**New Peroxide of Manganese Battery.**—G. Leclanché.—From the *Comptes Rendus*, lxxxiii., p. 54.

**Description of the Intensity Compass.**—J. Stamkart (*Arch. Neerl.*, xi., 197, 1876).—Already noticed.

**New Dynamo-magnetic Phenomenon.**—MM. Treve and Durassier.—From the *Comptes Rendus*, lxxxiii., 857.

**Elasticity and Flexibility of Ice.**—J. J. Bianconi (*Mem. de Acc. di Bologna*).—At lower temperatures ice is

perfectly brittle, but about zero it is capable of considerable deflection if submitted to a gradual pressure.

**Friction of the Ether.**—M. Hicks.—From *Nature*, xiv., 144.

**Seiches of the Swiss Lakes.**—F. A. Forel.—From the *Phil. Mag.*, ii., 447.

**Proceedings of the London Physical Society.**—From *Nature*, xv., p. 91.

*Gazzetta Chimica Italiana,*  
Anno vii., 1877, Fas. vii.

**The Expansion, the Capillarity, and the Viscosity of Melted Sulphur.**—G. Pisati.—The specific volume of virgin sulphur decreased from 0.000282 to 0.000010 during a progressive elevation of temperature from 125° to 159.5°, and increased again to 0.000210 on a further rise to 245°. From 125.6° to 190.6° the capillary elevation rose from 6.63 millimetres to 8.09. The viscosity of virgin sulphur reaches a minimum about 157°, augments then rapidly, reaches a maximum about 195°, and afterwards declines again.

**Sulph-acids of Normal Butyl-benzene.**—Luigi Balbiano.—Normal sulpho-butyl-benzinic acid is obtained by treating normal butyl-benzene with an excess of a mixture of equal weights of ordinary concentrated sulphuric acid and of Nordhausen acid. The salts and acid derivatives of this compound are briefly described.

**Coloured Reaction of Urea.**—Ugo Schiff.—If to a solution of urea in about three parts of the aqueous solution of furfural are added a few drops of concentrated hydrochloric acid, the liquid on heating assumes a magnificent violet colour, and in a short time coagulates into a black solid mass. The alcoholic solution gives rise to the same phenomenon.

**An Acetylen Urea.**—Ugo Schiff.—The product of the reaction of oxalic aldehyd upon urea may be considered as acetylen urea.

**Particular Decomposition of Boric Acid.**—Ugo Schiff.—About 25 grms. of triethyl borate were preserved in a phial, with a ground glass stopper, in a very damp place. In the neck of the bottle there occurred a fissure, through which a diffusion of aqueous vapour seems to have become established. After about two years, during which time the phial was untouched, the edge of the fissure was found covered with boric hydrate, whilst the contents of the bottle were transformed into a colourless, transparent, hard, vitreous mass.

**Researches on the Production of Salicylate of Iron.**—Dr. S. Barilari.—The author finds that by the prolonged action of salicylic acid at a boil a proto-salt is formed, which remains in this condition as long as nascent hydrogen is evolved.

**Propyl-isopropyl-benzene, and on the Propylbenzoic and Homo-terephthalic Acids, the Products of its Oxidation.**—E. Paterno and P. Spica.—Not suitable for useful abstraction.

*Revue Universelle des Mines,*  
May and June, 1877.

**Value of Belgian Iron Ores as compared with those of Foreign Origin.**—M. A. Habets.—The foreign ores here spoken of are chiefly derived from France. The memoir, which is far too bulky for abstraction, and which has been "crowned" by the Association of Engineers of the School of Liège, contains some interesting information on the behaviour of the phosphorus compounds in iron ores.

**Analysis of Saltpetre intended for the Manufacture of Gunpowder.**—A. Fresenius determines the moisture by heating to incipient fusion. The amount of insoluble matter is found by dissolving 100 grms. in hot

water, and collecting the insoluble matter on a small tared filter. The filtrate is acidulated with pure nitric acid, and the chlorine is determined gravimetrically with nitrate of silver. In this case the volumetric method does not give satisfactory results. In order to determine lime, magnesia, and soda, 100 grms. of saltpetre (to which about 1.5 grm. potassium chloride is added in order to decompose sodium nitrate) are dissolved in 100 c.c. of hot water, and the solution is then poured into half a litre of pure alcohol at 96 per cent, taking care to stir continually. The crystalline precipitate is collected on a filter previously well washed, and fitted with an aspirator, and washed with alcohol. The alcoholic liquid is submitted to distillation. The residue is dissolved in a little water, precipitated a second time with alcohol, and distilled again. A third precipitation with alcohol yields a liquid which contains all the lime, magnesia, and soda, and so small a quantity of potassic salts that their separation from the soda is practicable. This is only true when the sample contains no sulphate, as is generally the case; otherwise, the alcohol would occasion the precipitation of sulphate of lime. After having expelled the alcohol from the last liquid by evaporation, the nitrates are completely converted into chlorides by repeated evaporations with hydrochloric acid; the lime is then precipitated with a few drops of ammoniac oxalate, and in the filtrate the magnesia is thrown down with a small quantity of pure phosphate of ammonia in presence of ammonia. The filtrate is heated to expel ammonia, mixed with a few drops of ferric chloride, and then with ammonia or carbonate of ammonia till the reaction is faintly alkaline. Iron and phosphoric acid are thus removed. The filtrate is evaporated to dryness, the ammoniacal salts are expelled by heat, the potassa is separated by platinum chloride, and the sodium is determined as chloride. The composition of a sample of saltpetre analysed by this method was found to be—

Nitrate of potassa (by diff.) ..	99.8124
„ „ soda .. ..	0.0207
„ „ magnesia .. ..	0.0093
„ „ lime .. ..	0.0006
Chloride of sodium .. ..	0.0134
Insoluble matters .. ..	0.0210
Moisture .. ..	0.1226

100.0000

### NOTES AND QUERIES.

**Clarifying Gelatin.**—Can any correspondent tell me how to clarify gelatin without white of egg so as to make a thick transparent jelly, not to eat.—A. S.

**Graduation of Thermometers.**—Will you kindly inform me of a colouring material for the graduation of chemical thermometers, which will stand moderate heat and wear; that employed by the makers becoming useless almost immediately.—DELTA.

### NOTICE.

The STUDENTS' NUMBER of the CHEMICAL NEWS will be published on Friday next, September 21st. Gentlemen holding official positions in the Universities, Medical Schools, &c., of the United Kingdom, where Chemistry and Physical Science form a part of the education, who have not yet forwarded the necessary information to our Office for publication in that Number, will confer a favour by sending it with the least possible delay.

**Methylated Spirits.**—David Smith Kidd  
Licensed Maker, Commercial Street, Shoreditch, N.E.  
AS TO FINISH. FUSEL OIL and RECT. NAPHTHA.

**F. W. HART, Manufacturer and Dealer in**  
Apparatus and Chemicals for Scientific Pursuits. Laboratory Fitter and Furnisher. Photographic Apparatus and Materials  
8 and 9, KINGSLAND GREEN (WEST SIDE), LONDON.

**Water-glass, or Soluble Silicates of Soda**  
and Potash, in large or small quantities, and either solid in solution, at ROBERT RUMNEY'S, Ardwick Chemical Works Manchester.

Important Sale of Leasehold Interest in the GREENFIELD ALKALI WORKS, HOLYWELL, Flintshire, together with the whole of the Plant and Machinery, as a going concern.

**Messrs. CHURTON, ELPHICK, and CO.**  
have been instructed to SELL BY AUCTION, at the Grosvenor Hotel, Chester, on Tuesday, September 25th, 1877, at One for Two o'clock p.m. punctually, in one lot, and subject to such conditions as will then be produced, the valuable LEASEHOLD INTEREST in the above Premises, under a Lease for a term which expires on 25th December, 1892 (determinable by the Lessees or their assigns in 1878 or 1885 on six months' previous notice being given to the Lessors), at a rental of £250 per annum; together with the option given by such Lease to purchase the reversion in fee expectant on the determination of the term thereby granted for the sum of £5000; and together also with the whole of the extremely valuable PLANT, MACHINERY, and other Effects, which have been fixed and put upon the premises at a very heavy cost, including Steam Engines, Boilers, Lead Chambers, Iron Tanks, loose materials and other articles and things, schedules of which have been prepared and may be obtained as mentioned below.

The above premises are very extensive, and well adapted to carry on a large business; they have a frontage to an excellent road, and are close to the Holywell Station on the Chester and Holyhead Railway.

The premises may be viewed on applying to H. A. Cope, Esq., Solicitor, Holywell; and further information, and copies of the schedules above referred to, may be obtained on application to him; to Messrs. Churton, Elphick, Roberts, and Richardson, the Auctioneers, at their Mart in Foregate Street, Chester; or to Messrs. Broomhead, Wightman, and Moore, Solicitors, Bank Chambers, George Street, Sheffield.

### THE SUSSEX CHEMICAL WORKS, Near Shoreham. With Possession.

**Messrs. FULLER, HORSEY, SON, and CO.**  
are instructed to SELL BY AUCTION, at the Mart, Tokenhouse Yard, on Thursday, 27th September, at One precisely, the LEASE, PLANT, AND MACHINERY of the Sussex Chemical Works, together with the Contracts and Goodwill.

The Property is situate opposite Kingston-by-Sea, in the Parish of Lancing, on the River Adur, close to the mouth of the Harbour, and occupies an area of about 2½ acres. The Buildings comprise brick-built boiler-house, 32 feet by 25 feet, lean to in rear; brick- and timber-built ammonia-shed, 50 ft. by 28 ft.; lime-shed; brick-built laboratory; smith's shop; anthracene-shed, 52½ ft. by 23 ft.; store-house; pitch-chamber; pitch-bed; spacious yard; timber pontoon and landing-stage. The Plant and Machinery includes 5 wrought-iron stills, with 13 lb. lead-lined absorbers, brick seatings, furnace work, and chimneys; 3 tar stills (two 1500 and one 2400 gallons), with brick seatings and chimney-stacks and condensers; 5 steam-pumps; 2 Cornish steam-boilers; 4 lead-lined dipping-vats; range of 52 anthracene straining-bags; hydraulic press with 10-inch ram and pumps; iron store-tanks; and the necessary plant for carrying on the distillation of tar and the manufacture of sulphate of ammonia.

There is a wharf opposite on the bank of the river, having direct communication with the London, Brighton, and South Coast Railway. Vessels of 200 tons can load alongside the Works. Contracts and agreements are running with the Brighton and neighbouring Gas Companies for the whole of their tar and gas-liquor on most favourable terms, and there are other contracts for coals, pitch, &c., all of which will be included in the purchase.

The Property is held on Lease for an unexpired term of about 18 years at the very low rent of £32 per annum.

The loose tools and utensils, barges, tanks on rails, trolleys, &c., to be taken by a purchaser at a fair valuation.

May be viewed till the sale by orders which may be had of the Auctioneers. Particulars may be had of G. D. Hare, Esq., Solicitor, 18, Old Broad Street, E.C.; of Messrs. Ingledew, Ince, and Greening, St. Benet's Chambers, Gracechurch Street, E.C.; of Messrs. C. Browne, Stanley, and Co., 25, Old Jewry, E.C.; of Messrs. Cape and Harris, 8, Old Jewry, E.C.; at the Mart; and of Messrs. Fuller, Horsey, Son, and Co., 11, Billiter Square, London, E.C.

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MANUFACTURING AND OPERATIVE CHEMISTS,  
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Manufacturing Chemist, Tar and  
Ammonia Distiller,  
OFFICES: CATTEDOWN, PLYMOUTH.

Maker of Benzole, Toluole, Solvent and Burning Naphthas, Creosote Oils of all kinds, Naphthaline, Anthracene, Pitch, Carbolic Acid, Sulphate of Ammonia, &c., &c. NAPHTHA, LIGHT OIL, &c., PURCHASED AT MARKET RATES.

# THE CHEMICAL NEWS.

VOL. XXXVI. No. 923.

## UNIVERSITIES AND COLLEGES.

### UNIVERSITY OF LONDON.

CANDIDATES for any Degree granted by this University are required to have passed the Matriculation Examination, to which no candidate is admitted unless he has produced a certificate showing that he has completed his sixteenth year.

The Fee for this examination is £2.

The Examination will be held on Monday, January 14th, 1878. It is conducted by means of Printed Papers; but the Examiners are not precluded from putting, for the purpose of ascertaining the competence of the Candidates to pass, *viva voce* questions to any Candidate in the subjects in which they are appointed to examine.

Candidates are not approved by the Examiners unless they have shown a competent knowledge in each of the following subjects:—1. Latin. 2. Any two of the following Languages:—Greek, French, and German. 3. The English Language, English History, and Modern Geography. 4. Mathematics. 5. Natural Philosophy. 6. Chemistry.

The Papers in Latin and Greek will contain passages to be translated into English, with questions in Grammar and in History and Geography arising out of the subjects of the book selected. Short and easy passages will also be set for translation from other books not so selected. A separate paper will be set containing questions in Latin Grammar, with simple and easy sentences of English to be translated into Latin.

The papers in French and German will contain passages for translation into English, and questions in Grammar, limited to the Accidence.

The Latin subjects for 1878 and 1879 are—

For January, 1878:—*Livy*, Book II.

For June, 1878:—*Ovid*, *Epistolæ ex Ponto*, Book II.

For January, 1879:—*Cæsar*, *De Bello Gallico*, Books III. and IV.

For June, 1879:—*Cicero*, *De Senectute*, and the First Speech against *Catiline*.

Special stress is laid on accuracy in the answers to the Grammar questions, and on the correct rendering of English into Latin.

The Greek subjects for 1878 and 1879 are—

For January, 1878:—*Homer*, *Iliad*, Book X.

For June, 1878:—*Xenophon*, *Hellenics*, Book II.

For January, 1879:—*Homer*, *Odyssey*, Book XIV.

For June, 1879:—*Xenophon*, *Anabasis*, Book III.

Candidates may substitute German for Greek.

The Questions in Natural Philosophy are of a strictly elementary character; they include Mechanics, Hydrostatics, Hydraulics, Pneumatics, Optics, and Heat.

The Examination in Chemistry is—Chemistry of the Non-Metallic Elements; including their compounds—their chief physical and chemical characters—their preparation—and their characteristic tests.

A Pass Certificate, signed by the Registrar, will be delivered to each Candidate who applies for it, after the Report of the Examiners has been approved by the Senate.

If in the opinion of the Examiners any Candidates in the Honours Division of not more than Twenty years of age at the commencement of the Examination possess sufficient merit, the first among such Candidates will receive an Exhibition of thirty pounds per annum for the next two years; the second among such Candidates will receive an Exhibition of twenty pounds per annum for the next two years; and the third will receive an Exhibi-

tion of fifteen pounds per annum for the next two years; such exhibitions are payable in quarterly instalments, provided that on receiving each instalment the Exhibitor declares his intention of presenting himself either at the two Examinations for B.A., or at the two Examinations for B.Sc., or at the First LL.B. Examination, or at the Preliminary Scientific and First M.B. Examinations, within three academical years\* from the time of his passing the Matriculation Examination.

Under the same circumstances, the fourth among such Candidates will receive a prize to the value of ten pounds in books, philosophical instruments, or money; and the fifth and sixth will each receive a prize to the value of five pounds in books, philosophical instruments, or money.

Any Candidate who may obtain a place in the Honours Division at the Matriculation Examination in January is admissible to the First B.A. or to the First B.Sc. Examination in the following July. But such Candidate will not be admissible to the Second B.A. or to the Second B.Sc. Examination in the ensuing year, unless he has attained the age of eighteen years.

Several important changes have been made in the regulations relating to the Degrees in Science. These revised regulations relating to the *First B.Sc.* Examination will come into force at the Examination in July, 1877. Candidates presenting themselves at the *Second B.Sc.* Examination in October, 1877, will be allowed an option between the old and the revised regulations.

### FIRST B.SC. EXAMINATION.

The First B.Sc. Examination will commence on Monday, July 16, 1878.

No Candidate (with the exception of such as have obtained Honours at the Matriculation Examination in the preceding January) is admitted to this Examination within one academical year of the time of his passing the Matriculation Examination.

The Fee for this Examination is £5.

The Examination embraces the following subjects:—Pure and Mixed Mathematics, Inorganic Chemistry, Experimental Physics, and General Biology.

### Examination for Honours.

Any Candidate who has passed the First B.Sc. Examination in all its subjects may be examined at the Honours Examination next following the First B.Sc. Examination at which he has passed for Honours in (1) Mathematics, (2) Experimental Physics, (3) Chemistry, (4) Botany, and (5) Zoology; unless he has previously obtained the Exhibition in Pure and Mixed Mathematics at the First B.A. Examination, in which case he will not be admissible to the Examination for Honours in that subject; or unless he has previously obtained the Exhibition at the Preliminary Scientific (M.B.) Examination in either of the subjects which are common to it with the first B.Sc. Examination, in which case he will not be admissible to the Examination for Honours in that subject.

Candidates for Honours in Chemistry will be examined in Inorganic Chemistry, treated more fully than in the Pass Examination. In addition, they shall be examined practically in Simple Qualitative and Quantitative Analysis. This Examination, which will consist of six hours' examination by printed papers and of six hours' practical work, will take place on Thursday and Friday in the same week with the Examination for Honours in Mathematics, commencing on each day at 10 a.m.

\* By the term "Academical Year" is ordinarily meant the period intervening between any Examination and an Examination of higher grade in the following year; which period may be either more or less than a Calendar year. Thus the interval between the *First Examinations* in Arts, Science, and Medicine, and the *Second Examinations* of the next year in those Faculties respectively, is about sixteen months, whilst the interval between the *Second B.A.* Examination and the *M.A.* Examination of the next year, or between the *Second B.Sc.* Examination and the *D.Sc.* Examination of the next year, is less than eight months. Nevertheless, each of these intervals is counted as an "Academical Year."

In the Examination for Honours, the Candidate, not being more than 22 years of age at the commencement of the Pass Examination, who most distinguishes himself in Chemistry or Experimental Physics, will receive an Exhibition of £40 per annum for the next two years.

#### SECOND B.Sc. EXAMINATION.

The Second B.Sc. Examination will commence on Monday, October 22nd, 1878.

Candidates for this Examination are required to have passed the First B.Sc. Examination at least one academical year previously.

The Fee for this Examination is £5.

The regulations are framed with the view of allowing the candidate to bring up *any three* of the following nine subjects:—

1. Pure Mathematics.
2. Mixed Mathematics.
3. Experimental Physics.
4. Chemistry.
5. Botany, including Vegetable Physiology.
6. Zoology.
7. Animal Physiology.
8. Physical Geography and Geology.
9. Logic and Psychology.

It is understood the amount of proficiency expected in each of the three subjects chosen will be that which the candidate might attain by the steady devotion to it of about one-third of the sessional work of a diligent student.

#### Examination for Honours.

Any Candidate who has passed the Second B.Sc. Examination, and has not previously passed the Second B.A. Examination, may be examined at the Honours Examination next following the Second B.Sc. Examination at which he has passed, for Honours in (1) Mathematics, (2) Logic and Psychology, (3) Experimental Physics, (4) Chemistry, (5) Botany, (6) Zoology, (7) Physiology, (8) Physical Geography and Geology; provided that he shall have gone through the Pass Examination in the corresponding subject or subjects immediately before. And any Bachelor of Arts who has passed the Second B.Sc. Examination may under the same conditions be examined for Honours in one or more of the above mentioned subjects, unless he have previously obtained a Scholarship at the Second B.A. Examination in either of the first two of those subjects, in which case he shall not be admissible to the Examination for Honours in that subject.

The examination for Honours in Chemistry will take place on Monday and Tuesday in the second week after the conclusion of the Pass Examination; on Monday by printed papers (chiefly on Organic Chemistry), and on Tuesday by practical exercises in Simple Qualitative and Quantitative Analysis.

The candidate, being not more than 23 years of age, who most distinguishes himself in Chemistry, will receive £50 per annum for the next two years, with the style of University Scholar.

#### DOCTOR OF SCIENCE.

The examination for the Degree of Doctor of Science takes place annually within the first twenty-one days of June, and the examination in each branch occupies four days.

No candidate is admitted to the examination for the Degree of D.Sc. until after the expiration of two Academical Years from the time of his obtaining the Degree of B.Sc. in this University, unless he shall have passed the Second B.Sc. Examination in the First Division at least two Academical years subsequently to having passed the first B.Sc. Examination, in which case he shall be admitted to the examination for the Degree of Doctor in Science at the expiration of *one* Academical Year from the time of obtaining his B.Sc. Degree.

The Fee for this Examination is £10.

#### EXAMINATION IN SUBJECTS RELATING TO PUBLIC HEALTH.

A Special Examination is held once in every year in subjects relating to public health. It commences on the second Monday in December.

No candidate is admitted to this Examination unless he has passed the Second Examination for the Degree of Bachelor of Medicine in this University at least one year previously; nor unless he shall have given notice of his intention to the Registrar at least two calendar months before the commencement of the Examination.

The Fee for this Examination is £5.

Candidates are examined in the following subjects:—

*Chemistry and Microscopy*, in relation to the examination of Air, Water, and Food.

*Meteorology and Geology*, as far as they bear on the duties of Health Officers, viz.:—General knowledge of Meteorological Conditions; Reading and Correction of Instruments. General knowledge of Soils; their Conformation and Chemical Composition.

*Vital Statistics*, in reference to the methods employed for determining the Health of a Community; Birth-rate; Death-rate; Disease-rate; Duration and of Expectancy of Life. Present amount of Mortality, and its causes, in different Communities.

*Hygiene*.—General principles of Hygiene. Special topics:—Soil. Construction of Dwellings. Conservancy of Cities. Unhealthy Trades. Supply of Food to Cities, and Examination of Food. Disposal of Sewage. Water-supply.

*Medicine*, in reference to the origin, spread, and method of prevention of Diseases generally, but especially those of the Epidemic class.

*Sanitary Engineering*, as far as regards the arrangements connected with Water-supply, Sewerage, and Ventilation. A knowledge of the reading of Plans, Sections, Scales, &c.

*Sanitary Law*, as far as it relates to the duties of Officer of Health. A knowledge of the powers given under the various Sanitary Acts, as defined in the Instructions issued by the Local Government Board, and of the methods of procedure in special cases.

The Examination, which is both written and practical, extends over four days.

#### GILCHRIST SCHOLARSHIPS.

1. A Scholarship of the value of Fifty Pounds per annum, and tenable for three years, is annually awarded to the highest among those candidates at the June Matriculation Examination who have been approved by the Principal of University Hall as fit to be received into that Institution with a view to the prosecution of their studies in University College for Graduation in one of the four Faculties of the University of London; provided that such Candidate pass either in the Honours List or in the First Division.—Particulars may be obtained on application to the Principal of University Hall, Gordon Square, W.C.

2. A similar Scholarship is annually awarded to the Candidate from the Royal Medical College, Epsom, who at the June Matriculation Examination stands highest among the Candidates approved by the Head Master of that Institution, and who passes either in the Honours List or in the First Division; on condition of his prosecuting his studies during the tenure of his Scholarship with a view to Graduation in one of the four Faculties of the University of London.—Particulars may be obtained on application to the Secretary of the Royal Medical College, 37, Soho Square, W.

3. A similar amount is annually offered to Candidates intending to pursue, at Owens College, Manchester, their studies for Graduation in one of the four Faculties of the University of London; a single Scholarship of Fifty Pounds per annum for three years being awarded to the highest of those Candidates at the June Matriculation Examination who shall have been previously approved by the Principal of Owens College, provided that he pass in

the Honours Division; or, in case no Candidate should so pass, two Scholarships, each of Twenty-five Pounds per annum, being awarded to the two Candidates as aforesaid who shall stand highest in the First Division.—Particulars may be obtained on application to the Principal of Owens College, Manchester.

Particulars of the Colonial and Indian Scholarships may be obtained on application to the Secretary of the Gilchrist Educational Trust, University of London, W.

#### UNIVERSITY OF OXFORD.

*Professor of Chemistry.*—W. Odling, M.A., F.R.S.

*Professor of Mineralogy.*—N. S. Maskelyne, M.A., F.R.S.

*Demonstrator of Chemistry.*—J. Fisher, M.A.

*Analyst in Sanitary Laboratory.*—W. F. Doukin, M.A.

Every Student must reside in one or other of the Colleges or Halls, or in licensed lodgings, for a period of three years, passing at least two examinations in Arts, and one in either Mathematics, Natural Science, Law, Modern History, or Theology, when, if he obtain a first, second, or third class, he can take his B.A. Degree; if he do not gain such honour he has to pass a third examination in *Literis Humanioribus*.

The instruction in Natural Science is carried on at the Museum, where there is practical instruction in Physics, Chemistry, Anatomy, and several other departments of natural science, together with courses of lectures and of practical instruction and work, by the several professors.

Scholarships of about the value of £75 are obtainable at Christ Church, Magdalen, and other colleges, by competitive examination in Natural Science.

More detailed information may be obtained from the University Calendar; from the professors; from E. Chapman, Esq., M.A., Frewin Hall; and from the Sub-Librarian in the Radcliffe Library or the Museum.

#### UNIVERSITY OF CAMBRIDGE.

*Professor of Chemistry.*—G. D. Liveing, M.A.

*Jacksonian Professor of Natural and Experimental Philosophy.*—J. Dewar, M.A.

*Demonstrators.*—J. W. Hicks, M.A., W. J. Sell, B.A., and H. J. H. Fenton.

The Student must enter at one of the Colleges, or as a Non-collegiate Student, and keep terms for three years by residence in the University. He must pass the previous examination in Classics and Mathematics, which may be done in the first or second term of residence, or, through the Oxford and Cambridge Schools Examination Board, or through the Senior Local Examinations, before commencing residence. He may then proceed to take a Degree in Arts, either continuing mathematical and classical study, and passing the ordinary examinations for B.A., or going out in one of the Honour Triposes.

The scholarships, ranging in value from £20 to £80 a year, are chiefly given for mathematical and classical proficiency. Scholarships are given for Natural Science in Trinity, St. John's, St. Peter's, Clare, Christ's, Sidney, Pembroke, Caius, and Downing Colleges; the examinations being at Easter, and in June and October.

The Chemical Laboratory of the University is open daily for the use of the Students. The Demonstrator attends daily to give instructions.

Non-collegiate Students are allowed to attend certain of the College Lectures and all the Professors' Lectures, and have the same University status and privileges as the other Students. They are under the superintendence of the Rev. R. B. Somerset, Orford House, Cambridge, from whom further information may be obtained.

The following are the Lectures on Chemistry for the ensuing Academical Year:—

#### MICHAELMAS TERM, 1876.

General Course, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12 noon. Begin Oct. 15.

Spectroscopic Analysis, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 1.30 p.m. Begin Oct. 15.

Analysis, by the Professor and the Demonstrators of Chemistry. Daily. Begin Oct. 8. Also at St. John's College, by Mr. Main. Begin Oct. 16.

Physical Chemistry, by the Jacksonian Professor, on Tuesdays, Thursdays, and Saturdays, at 12 noon. Begin Oct. 16.

Elementary Organic Chemistry, by Mr. Main, at St. John's College, on Tuesdays, Thursdays, and Saturdays, at 11 a.m. Begin Oct. 16.

Volumetric Analysis, by Mr. Apjohn, at Caius Laboratory, on Mondays, Wednesdays, and Fridays, at 10 a.m. Begin Oct. 17.

Catechetical Lectures, by Mr. Lewis, at Downing College, on Mondays, Wednesdays, and Fridays, at 9 a.m. Begin Oct. 15.

#### LENT TERM, 1877.

General Course continued, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12 noon. Begin Jan. 30.

Analysis, by the Professor or Demonstrators of Chemistry. Daily. Begin Jan. 21. Also at St. John's College, by Mr. Main. Begin Jan. 31.

Organic Chemistry, by the Jacksonian Professor, on Tuesdays, Thursdays, and Saturdays, at 12 noon. Begin Jan. 31.

General Course, begun by Mr. Main, at St. John's Laboratory, on Tuesdays, Thursdays, and Saturdays, at 11 a.m. Begin Jan. 31.

Non-metallic Elements, by Mr. Apjohn, at Caius Laboratory, on Mondays, Wednesdays, and Fridays, at 10 a.m. Begin Feb. 1.

Catechetical Lectures, by Mr. Lewis, at Downing College, on Mondays, Wednesdays, and Fridays, at 9 a.m. Begin Feb. 1.

#### EASTER TERM, 1877.

Some Special Department, by the Professor of Chemistry, on Mondays, Wednesdays, and Fridays, at 12 noon. Begin May 2.

Analysis, by the Professor or Demonstrators of Chemistry. Daily. Begin May 6. Also at St. John's College, by Mr. Main. Begin May 2.

Elementary Chemistry, by the Demonstrator of Chemistry, on Tuesdays, Thursdays, and Saturdays, at 3 p.m. Begin May 3.

General Course concluded, by Mr. Main, at St. John's Laboratory, on Tuesdays, Thursdays, and Saturdays, at 12 noon. Begin May 3.

Elementary Organic Chemistry and Analysis, by Mr. Apjohn, at Caius Laboratory, on Mondays, Wednesdays, and Fridays, at 10 a.m. Begin May 1.

Catechetical Lectures, by Mr. Lewis, at Downing College, on Mondays, Wednesdays, and Fridays, at 9 a.m. Begin April 30.

#### UNIVERSITY OF DUBLIN.—TRINITY COLLEGE

The Chemical Laboratory will re-open on October 1st, 1877. During the vacation a new Hall has been added to the Laboratory, whereby working accommodation for one hundred Students is provided.

The University Professor of Chemistry, Dr. Emerson Reynolds, assisted by the Demonstrator of Chemistry Mr. Early, conducts the undermentioned Courses of Laboratory instruction:—

*The First Course of Practical Chemistry.*—Michaelmas Term:—Qualitative Analysis and the Use of the Spectroscope. Hilary Term: Volumetric and Simple Gravimetric Analysis. Trinity Term: Organic Preparations and Analysis.

Students can also attend the Professor's Lectures on General Chemistry, and repeat most of the experiments performed in the Theatre.

This Course terminates on the last day of June.

*The Second or Advanced Course* includes instruction in the higher branches of Experimental and Analytical Chemistry, and in Methods of Research. Students who take out this Course are free to devote their chief attention to the study of special departments of Chemistry as applied to Arts and Industries.

*Summer Course of Practical Chemistry for Medical Students.*—This Course commences on the first Monday in April and terminates on the 30th of June following. Students experiment in the Laboratory from 2 to 4 o'clock on Tuesdays, Thursdays, and Saturdays.

*Special Courses.*—Students can enter at any time throughout the academic year for short terms of Laboratory instruction in Medical or Pharmaceutical Chemistry, or in the Methods of Analyses of Water, Air, &c., for Sanitary Purposes.

*Lectures in Medical and Pharmaceutical Chemistry.*—Dr. Reynolds lectures at 2 o'clock on Tuesdays, Thursdays, and Saturdays, from the 1st of November to the 31st of March following.

All the classes are open to extra-Academic Students.

#### SCIENCE AND ART DEPARTMENT OF THE COMMITTEE OF COUNCIL ON EDUCATION, SOUTH KENSINGTON,

AND

#### ROYAL SCHOOL OF MINES, JERMYN STREET.

A sum of money is voted annually by Parliament for scientific instruction in the United Kingdom. The object of the grant is to promote instruction in Science, especially among the industrial classes, by affording a limited and partial aid or stimulus towards the founding and maintenance of Science schools and classes.

The assistance granted by the Science and Art Department is in the form of—1. Public Examinations, in which Queen's Medals and Queen's Prizes were awarded, held at all places on complying with certain conditions. 2. Payments on results to teachers. 3. Scholarships and Exhibitions. 4. Building Grants. 5. Grants towards the purchase of apparatus, &c.

The following Courses of Lectures, Demonstrations, and Practical Laboratory instruction are given at South Kensington:—

*Chemistry*, by Professor Frankland, D.C.L., F.R.S. A Course of Forty Lectures on Inorganic Chemistry, commencing October 1, 1877. A Course of Thirty Lectures on Organic Chemistry, commencing January 14, 1878. Fees—Lectures on Inorganic Chemistry, £4; Lectures on Organic Chemistry, £3; together, £6.

*Chemical Laboratories.*—The Laboratories for instruction in chemical manipulation, in qualitative and quantitative analysis, the technical application of analysis, and in the method of performing chemical researches, are under the direction of Dr. Frankland, and will be opened on Monday, October 1, 1877. The Laboratories at South Kensington Museum are now used for the instruction of the Pupils of the Royal School of Mines.

The charge for instruction in the Chemical Laboratory is £12 for three months, £9 for two months, and £5 for one month.

*Physics*, by Professor Frederick Guthrie, F.R.S. The Course will consist of about Sixty Lectures, with Laboratory work on the subject of the Lectures.\* The Course will commence on October 1, 1877. Fee for Lectures and Laboratory work, £10.

*Metallurgy*, by Dr. Percy, F.R.S. The Course will consist of about Fifty Lectures, commencing on October 22, 1877.

*Metallurgical Laboratory.*—This Laboratory is conducted by Mr. R. Smith, under the direction of Dr. Percy, and is devoted to practical instruction in Metallurgy, especially in Assaying. The nature of this instruction

will be adapted to the special requirements of the Student. It comprises:—Assaying in all its branches, especially of the more important metals, such as iron, copper, lead, tin, alloys of silver and gold, &c.; and the examination of ores and metallurgical products.

The ability of the Student to make trustworthy assays is in every case thoroughly tested; and no certificate of competency is given to a Student who has not furnished satisfactory proof that he is able to obtain accurate results.

The charge for instruction in the Metallurgical Laboratory is £15 for three months, £12 for two months, and £7 for one month.

Besides the Students entering for the Associateship of the Royal School of Mines, and Teachers in Training, only such a limited number of occasional public Students will be admitted as can be accommodated. Letters with respect to the foregoing Courses should be addressed to the Secretary, Science and Art Department, South Kensington, London, S.W.

*Lectures to Working Men.*—Short Courses of Lectures at suitable periods of the year are given in the evening to Working Men. These courses are systematic, and arranged so as to illustrate, within a period of two years, the principal subjects taught at the institution. Those for the ensuing Session include Geology, Natural History, Metallurgy, and Physics.

#### EXHIBITIONS, SCHOLARSHIPS, AND PRIZES.

There are various Exhibitions, Scholarships, and free admissions attached to the School. They are as follow:—

##### *Royal Exhibitions.*

There are nine Royal Exhibitions to the Royal School of Mines, Jermyn Street, of the value of £50 per annum, entitling the holders to free admission to all the lectures and the chemical and metallurgical laboratories at the Royal School of Mines, to be held from year to year for three years, on the condition that the holder attends the courses regularly during those years, complies with all the rules laid down for his guidance, and passes the examinations required for the associateship of the school.

##### *Free Admissions.*

A free admission, conferring the privilege of attending all Lectures and Examinations without the payment of fees, is offered to any person who obtains a Queen's Gold Medal at the annual May Examinations of the Science and Art Department.

##### *Royal Scholarships.*

Two Scholarships, of fifteen pounds each, are given to the Students who shall stand highest on the list of those who have passed their Examinations for the first year; and a Scholarship of twenty-five pounds to that pupil who has gained the greatest number of marks in the examinations of the first two years.

#### KING'S COLLEGE.

(DEPARTMENT OF ENGINEERING AND APPLIED SCIENCE.)

*Professor of Chemistry.*—C. L. Bloxam, F.C.S.

*Demonstrator.*—W. N. Hartley, F.C.S.

*Assistant Demonstrator.*—J. M. Thomson, F.C.S.

I. For Students intending to devote themselves to Medicine, Pharmacy, or Scientific Chemistry, or to take a degree in Medicine or Science in the University of London. A course of between sixty and seventy Lectures, by the Professor, commencing in October and terminating in March. Inorganic Chemistry, October till January. Organic Chemistry, February and March. On Monday, Wednesday, and Thursday, from 10.15 till 11.15. Fee, £8 8s. for the course, or £11 11s. perpetual attendance.

II. For Students intending to devote themselves to Engineering, Manufacturing Chemistry, Mining, Scientific

\* A detailed account of the Laboratory Instruction in Physics will be found in the Students' Number of the CHEMICAL NEWS for 1875 (No. 824).

Chemistry, Commerce, Agriculture, Manufactures, Military Science, the Civil Service, and for those who are studying Chemistry for the sake of general information and as part of a liberal education. A Course of between fifty and sixty Lectures, by the Professor, carried on during the whole academical year. This Course is of such a character that Students may enter, without serious disadvantage, at the commencement of either of the College Terms. On Tuesday and Friday, from 10.20 till 11.20. Fee, £3 3s. a term, or £8 8s. for the year.

III. For Students who have any Examination in prospect, or who require general guidance in their Chemical studies. A Course of ten or twelve Lectures in each College Term, by the Assistant Demonstrator. On Saturday, from 11.15 till 12.15. Fee, £1 1s. for each term.

#### EVENING CLASSES.

For Students who are preparing for any Examination, or who require a general knowledge of Chemistry applicable to any pursuit.

A. A Course of about forty Lectures, by the Demonstrator, commencing in October and terminating in March. On Monday and Thursday evenings, from 7 till 8. Fee, £1 11s. 6d. for the Course.

B. A Summer Course of about ten Lectures, in April, May, and June. On Monday evenings, from 6.30 till 7.30. Fee, £1 1s. for the Course.

#### PRACTICAL CHEMISTRY.

For the study of Chemical Analysis of Inorganic and Organic Substances, as far as it is required in most Examinations. This Course is also preliminary to the study of Practical Chemistry in general.

Each Student works independently in the Laboratory, which is open in October, November, December, January, February, March—On Tuesday evening, from 7 till 9 p.m. Fee, £2 2s. for the Course.

II. May, June, July—On Monday, Tuesday, Wednesday, and Thursday, from 10.15 till 12.15 a.m. Fee, £5 5s. for the Course.

III. Each College Term—On Tuesday and Friday, from 10.20 till 11.40. Fee, £4 4s. per Term.

#### LABORATORY OF ANALYTICAL AND EXPERIMENTAL CHEMISTRY.

For the study of all branches of Practical Chemistry. Each Student works independently in the Laboratory, which is open during all College Terms, on every day (except Saturday) from 10 till 4, and on Saturday, from 10 till 1. Fees, Experimental and Analytical Chemistry—One month, £4 4s.; three months, £10 10s.; six months, £18 18s.; nine months, £26 5s.

#### UNIVERSITY COLLEGE. FACULTY OF SCIENCE.

*Chemistry.*—Professor Williamson, Ph.D., F.R.S.  
*Assistant Professor.*—Charles Graham, D.Sc.

#### A. GENERAL COURSE.

Lectures daily (except Saturday) from 11 to 12 a.m., up to the last week in March.

Exercises on Tuesdays, Wednesdays, Thursdays, and Fridays, from 9 to 10 a.m.

Fee for the whole Course of Lectures, £7 7s.; for the First or Second Half Course separately, £4 4s.; for the Second Half, when the first has been taken, £3 3s.; Perpetual, £9 9s.; for the Organic Course alone, £2 2s.

Fee for the Exercise Class, £2 2s.

The instruction in this Class is of two kinds, consisting partly of Experimental Lectures by the Professor, partly of Exercises and personal instruction on the subject of the Lectures by the Assistant Professor.

A weekly *viva voce* examination is held during the First Half Course and the commencement of the Second Half Course.

*Organic Chemistry* commences in the second week in February, and occupies five Lectures weekly till about the end of March.

Teachers of Chemistry are trained in the theory and practice of their profession. A two years' Course is absolutely requisite for this purpose; but Students will with advantage devote a longer period to it.

The first year is occupied with attendance on the Courses of Chemistry and of Analytical Chemistry. In the second year the Student again attends the Course of Chemistry, and is entrusted with teaching work in conjunction with the Tutors of the Class. At the same time he continues to work in the Laboratory at analysis and original research.

In order to qualify themselves for rising to the higher ranks of the Profession, gentlemen remain for a further period, in which case they may obtain remunerative work in teaching through the recommendation of the Professor.

#### B.—ANALYTICAL AND PRACTICAL CHEMISTRY.

##### I. Birkbeck Laboratory.

The Laboratory and offices are open daily from 9 a.m. to 4 p.m., from the 3rd of October until the end of July, with a short recess at Christmas and at Easter. Saturday, from 9 to 2.

Fees, for the Session, 25 guineas; six months, 18 guineas; three months, 10 guineas; one month, 4 guineas; exclusive of the expense of materials.

##### II. Summer Courses.

1. *Elementary Course.*—About forty Lessons. of one hour each, on Tuesday, Wednesday, Thursday, and Friday, from 11 to 12, commencing in the first week of May.

Fees, including the cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

2. *Senior Course.*—This Course consists of twenty Lessons of two hours each, on Mondays and Saturdays, from 10 to 12, commencing in the first week in May.

Fees, including cost of materials and apparatus, for the Course, £4 4s.; Perpetual, £7 7s.

#### UNIVERSITY COLLEGE, BRISTOL.

*Professor of Chemistry.*—E. A. Letts, Ph.D., F.R.S.E.  
*Assistant Lecturer.*—W. W. J. Nicol, M.A.

#### Scholarships.

The following Scholarships will be offered in October:—

One Chemical Scholarship of the value of £25, tenable for one year.

Subjects of examination;—1st. A qualifying examination in the subjects required for the General Scholarships. 2nd. A Special Competitive Examination in Chemistry, both written and practical.

Three General Scholarships of the value of £15 each, tenable for one year.

The successful candidates for these General Scholarships will be required to attend at least three subjects of Lectures and Classes at the College.

The First Term will commence on the 9th of October and end on the 20th of December, 1877. The Second Term will commence on the 9th of January and end on the 4th of April, 1878. The Third Term will commence on the 25th of April and end on June 28th, 1878.

#### Inorganic Chemistry.

This Course will consist of Three Lectures a week, and will be continued during the First and Second Terms. They will be devoted to a consideration of the Theory of Chemistry, Chemical Physics, and Descriptive Inorganic Chemistry. In treating of the various substances under the latter heading, special attention will be given to their applications in the arts and manufactures. Fee £3 3s.

*Laboratory Instruction.*

The College Laboratory will be open daily at 10 a.m. Instruction will be given in the Laboratory in all branches of Practical Chemistry, including Qualitative and Quantitative Inorganic and Organic Analysis, the preparation of Chemical Products, and Inorganic and Organic Research, special facilities being afforded to those who desire to study Practical Chemistry, as applied to the different processes employed in the Arts and Manufactures. Each Student will be required to provide, at his own expense, a set of ordinary apparatus at a cost of about 2rs. The cost of material for original research must also be paid by the student requiring it.

Fees—per Session:—Students working 6 days per week, £18 18s.; 3 days per week, £10 10s. Per Term:—Students working 6 days per week, £7 7s.; 3 days per week, £4 4s. Per month:—Students working 6 days per week, £3 3s.; 3 days per week, £2 2s.

ROYAL AGRICULTURAL COLLEGE,  
CIRENCESTER.

## CHEMICAL DEPARTMENT.

*Professor of Chemistry.*—A. H. Church, M.A., Oxon.

The Collegiate year is divided into two Sessions, one beginning in February and ending in June, the other beginning in August, dividing in October, and ending in December.

During each Session the following Courses are given:—

- 36 Lectures on Inorganic Chemistry.
- 36 Lectures on Organic Chemistry.
- 36 Lectures on Agricultural Chemistry.
- 36 Laboratory Lessons in Chemical Manipulation.
- 36 Laboratory Lessons in Qualitative Analysis.
- 36 Laboratory Lessons in Quantitative Analysis.

The College Laboratory is open every day, except Saturday, from 9 a.m. till 5 p.m.

Advanced Students have the privilege of working at all times when the Laboratory is not occupied by other classes.

## THE YORKSHIRE COLLEGE, LEEDS.

*Professor of Chemistry.*—T. E. Thorpe, Ph.D., F.R.S., F.C.S.

On October 23, 1877, the Foundation Stone of the New Buildings of this College will be laid by the Archbishop of York.

The Textile Industries Department, for which the Clothworkers' Company have given £10,000, will be the first section taken in hand. The promises of donations are now nearly £60,000, besides an income of £1000 per annum from endowments.

*Lecture Courses.*

1. General Course on Inorganic and Organic Chemistry—Monday, Tuesday, Wednesday, and Thursday, at 4 p.m., from October to the end of March. Fee for the Course, £4 4s.

2. Lectures on Laboratory Practice and Chemical Calculations—Thursday, at 10 a.m., during the First and Second Series. Fee, £1 1s.

3. Lectures on the Chemistry of the Non-Metals—Saturday, at 12 a.m., during the First and Second Terms. Fee, 10s. 6d.

*Laboratory Courses.*

The College Laboratory will be open daily from 9 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturdays, when it will close at 1 p.m.

Fees for the Session:—Students working six days per week, £17 17s.; four, £13 13s.; three £11 11s.; two, £8 8s.; one, £4 4s.

*Class in Practical Chemistry*, Saturday mornings, from 9 to 12, during First and Second Series. Fee £1 11s. 6d.

*Practical Chemistry for Medical Students.*—On Monday

and Wednesday, from 9 to 11 a.m., from May to the end of July.

*Scholarships.*

The Cavendish Scholarship. Value £50 per annum, tenable for one year. Awarded for investigations made by the Candidates in any branch of Natural Science taught in the College.

The Salt Scholarship. Value £20 per annum, tenable for two years.

Akroyd Entrance Scholarships. Value £25 per annum, tenable for three years. Intended for the encouragement of the study of Natural Science. One of these Scholarships will be awarded annually, if in the opinion of the Examiners any Candidate shall possess sufficient merit.

The Clothworkers' Company Scholarships. Four Scholarships, each of the value of £25 per annum, and tenable for one year. Each Scholar will be required to attend regularly the Lectures and Courses of instruction given in the First and Second Years' Course of the Department of Textile Industries at the discretion of the Instructor.

COLLEGE OF PHYSICAL SCIENCE,  
NEWCASTLE.

(IN CONNECTION WITH THE UNIVERSITY OF DURHAM.)

*Professor of Chemistry.*—A. Freire-Marreco, M.A. *Demonstrator*—J. T. Dunn, Assoc. Phys. Science.

*Practical Chemistry.*—The Laboratory is open from 10 a.m. to 1 p.m., and from 2 to 5 p.m., except on Saturdays, when it closes at 1 p.m. *Laboratory Fees.*—Students working six days per week, £5 5s. per term; alternate days, £3 3s.; one day per week, £1 1s.

Arrangements for Laboratory work in the evening and during vacation will be made.

*Courses of Study.*—Students will be distinguished into Regular and Occasional. Regular Students will be required to follow such a course of study in the subjects professed in the College as will enable them to pass the Examinations for the title of Associate in Physical Science. Occasional Students will attend such classes as they may select.

The Session will commence on the 2nd October, 1876.

*Evening Classes.*—Professor A. Freire-Marreco, M.A. Twelve Lectures on the Principles of Modern Chemistry, and its relation to other Molecular Forces. Mondays, at 7.45, commencing October 29, 1877.

## OWENS COLLEGE, MANCHESTER.

*Professor and Director of the Chemical and Metallurgical Laboratories.*—H. E. Roscoe, B.A., Ph.D., F.R.S., F.C.S.

*Professor of Organic Chemistry.*—C. Schorlemmer, F.R.S.

*Demonstrators and Assistant Lecturers.*—Mr. W. C. Williams, F.C.S., Mr. M. M. Pattison Muir, F.R.S.E., and Mr. Thomas Carnelley, D.Sc.

*Hon. Demonstrator in Metallurgical Laboratory.*—Mr. James Taylor.

*Lecture Courses.*

*Systematic Chemistry.*—*Junior Class.*—Tuesday, Thursday, and Saturday, from 9.30 to 10.30 a.m., during Michaelmas and Lent Terms. Comprising—(1) The laws of Chemical Combination; (2) a description of the physical and chemical properties and the mode of preparation of the Non-Metallic Elements and of their Compounds.

*Senior Class.*—Monday, Wednesday, and Friday, from 9.30 to 10.30 a.m., during the Michaelmas and Lent Terms, comprising—(1) The Chemistry of the Metals and of their most important Compounds; (2) Organic Chemistry.

The instruction in Systematic Chemistry is given by means (a) of Experimental Lectures and (b) of Tutorial Classes.

Fee—For each Class, £2 12s. 6d.; for both Classes, £4 14s. 6d.

A Tutorial Class, meeting in Sections, will also be held, which all members of the Junior and Senior Classes will be required to attend, unless specially exempted by the Principal and the Professor. Extra fee for this Class, 10s. 6d. This fee is not included in the composition fees payable by regular Students.

*Organic Chemistry.*—Professor C. Schorlemmer, F.R.S. Tuesday, Thursday, and Friday, from 2.30 to 3.30 p.m.

The subject of this Course is the Chemistry of the Carbon Compounds, wherein the branch of Organic Chemistry is more fully and completely treated than in the general Course in Systematic Chemistry.

Fee, £3 10s.

*Technological Chemistry.*—Monday and Wednesday, from 2.30 to 3.30 p.m.

The chemical principles involved in the most important Chemical Manufactures will chiefly be considered in this Course. The subject will be discussed as follows:—

1. Twenty Lectures on Water, Air, and the Chemistry of Fuel and the Gas Manufacture, by Mr. Muir.

2. Twenty Lectures on the Chemistry of Colouring-Matter, Dyeing, and Calico-Printing, by Professor Schorlemmer.

Students attending this Class must be acquainted with the principles of chemical science.

Fee, £1 11s. 6d.

*Chemical Philosophy.*—Prof. C. Schorlemmer, F.R.S. Saturday, from 9.30 to 10.30 a.m.

Sketch of the History of Chemistry; Development of Modern Chemistry; Chemical Laws and Theories; Relation of Chemistry to Physics.

Fee, £1 11s. 6d.

*Analytical Chemistry.*—Mr. W. C. Williams, F.C.S. Thursday, from 10.30 to 11.30 a.m.

This Course will treat of the methods of Qualitative and Quantitative Analysis, and is intended to supplement the instruction in Practical Chemistry.

Fee, £1 11s. 6d.

#### *Analytical and Practical Chemistry.*

##### LABORATORY COURSES.

The Chemical Laboratories will be open for Students daily from 9.30 a.m. until 4.30 p.m., except on Saturdays, when they will be closed at 12.30 p.m.

Fees for the Session—For six days per week, £21; for four days per week, £17 17s.; for three days per week, £13 13s. Students entering the Laboratory Class at or after Christmas will be charged two-thirds of the fees for the whole Session.

Fees for shorter periods—For six months, £17 17s.; for five months, £15 15s.; for four months, £13 13s.; for three months, £10 10s.; for two months, £7 7s.; for one month, £4 4s. Students entering under this scale are entitled to work on every day during the week.

##### *Entrance Exhibitions.*

I. Victoria Exhibition (Classics), £15.

II. Wellington Exhibition (Greek Testament), £15.

III. Dalton Mathematical Exhibition, £15.

The Victoria and Dalton Exhibitions are renewable for a second year.

IV. Grammar School Scholarships, £15 per annum, tenable for three years; open to scholars of the Manchester Grammar School only.

V. Two Oxford and Two Cambridge Local Exhibitions, giving free admission to lecture classes in the College for one year, and renewable for two years further; awarded on the results of the Oxford and Cambridge Examinations held in Manchester respectively in June and December, 1877.

VI. Gilchrist Scholarship, £50 per annum, tenable for three years; awarded on the results of the Matriculation Examination of the University of London, in June, 1878.

VII. Rumney Scholarships, £45 per annum, tenable for three years. The next competition will take place in 1878.

VIII. Ramsbottom Scholarship, £40 per annum, tenable for two years. The next competition will take place in 1879.

IX. Four Whitworth Exhibitions, giving free admission to certain Day Lecture Classes, which will enable the holders to prepare themselves for the competition for the Scholarships of £100 per annum founded by Sir Joseph Whitworth, Bart.

##### *Scholarships and Prizes.*

The following (except the Shakspeare Scholarship) are open to the competition of students of the College only. The regulations prescribing the terms of competition and tenure will be found in the "Calendar."

I. Victoria Scholarship (Classics), £40 per annum, tenable for two years.

II. Wellington Scholarship (Greek Testament), £20 per annum, tenable for two years.

III. Shuttleworth (Political Economy), £50, tenable for one year.

IV. Shakspeare Scholarship (English Language and Literature), £40 per annum, tenable for two years.

V. Dalton Chemical Scholarships, two, each of £50 per annum, tenable for two years.

VI. Dalton Mathematical Scholarships, one Senior and one Junior Scholarship, of the value of £25 each, tenable for one year.

VII. Heginbottom Physical Scholarship, £20 per annum, tenable for two years.

VIII. Ashbury Scholarships (Engineering), two, each of £25 per annum, tenable for two years.

IX. Platt Scholarships (Physiology), two, each of £50 per annum, tenable for two years.

X. Crace-Calvert Scholarship (Chemistry), £25, tenable for two years; open to Evening Students in Chemistry only.

XI. Dalton Natural History Prize, value £15.

XII. Shuttleworth History Prize, value £5.

XIII. Classical Essay Prize, value £5.

XIV. Junior Classical Prizes, value £5 and £2 10s.

XV. Lee Greek Testament Prizes, one of £25 and one of £12 10s. value.

XVI. English Essay and Poem Prizes, each of the value of £5.

XVII. Engineering Essay Prize, value £5.

XVIII. Early English Text Society's Prizes.—A selection of the Society's publications offered to the competition of students in the Day and in the Evening Classes respectively.

XIX. Cobden Club Book Prizes (Political Economy).

XX. Bryce Law Prize, value £10.

XXI. New Shakspeare Society's Book Prizes.

#### ROYAL COLLEGE OF SCIENCE FOR IRELAND STEPHEN'S GREEN, DUBLIN.

*Professor of Practical and Theoretical Chemistry.*—R. Galloway, F.C.S.

The Chemical and Metallurgical Laboratories, under the direction of Mr. Galloway, are open every week-day during the Session, except Saturday. Instruction is given in the different branches of Analytical Chemistry, including Assaying, and in the methods for performing Chemical Research. Fee, for the Session of nine months, £12; or for three months, £5; or for one month, £2.

There are four Royal Scholarships of the value of £50 each yearly, with Free Education, including Laboratory Instruction, tenable for two years; two become vacant each year; they are given to Students who have been a year in the College. There are also nine Exhibitions attached to the College, of the yearly value of £50 each, with Free Education, including Laboratory Instruction, tenable for three years; three become vacant each year.

A Diploma of Associate of the College is granted at the end of the three years' course.

The Session commences on Monday, October 1st.

#### ANDERSON'S COLLEGE, GLASGOW.

*Chemical Department.*—Professor W. Dittmar, F.R.S.E.

WINTER SESSION, 1877-78.

I. Lectures on Chemistry; daily, Saturdays excepted, from 10 to 11 a.m., commencing on November 1. A Course of about 100 Experimental Lectures, comprising Inorganic Chemistry, the more important chapters of Organic Chemistry, and the elements of Chemical Philosophy. Fee, £2 2s., except to students wishing to graduate in Edinburgh University, who must pay the Glasgow University Fee of £3 3s.

II. The Laboratory, for practical instruction in analysis, technical assaying, and the preparation of chemicals, and for original investigation, is open daily, Saturdays excepted, from 10 to 5, commencing on October 15.

Fees for the Session—To students working full time, £10 10s.; to students attending twice a week, each time for two stated consecutive hours, £5 5s., inclusive of the use of instruments, of the more expensive apparatus, and of the laboratory sets of reagents.

III. Evening Class for Practical Chemistry. Mondays, from 7.30 to 9.30 p.m., commencing on October 15. Fee for the Session, £3 3s., inclusive of all apparatus and chemicals.

IV. Popular Evening Lectures on Organic Chemistry. (The "Freeland Lectures.") Fridays, from 8.30 to 9.30, commencing October 5.

During the Summer Session, which commences early in May and terminates at the end of July, the Laboratory will be open daily from 9 to 5, Saturdays excepted. Fee to students working full time £6 6s.; attending twice a week, each time for two stated consecutive hours, £3 3s.

The Practical Class for Medical Students will meet thrice a week, for two hours each time.

#### THE "YOUNG" CHAIR OF TECHNICAL CHEMISTRY, ANDERSON'S COLLEGE.

*Professor.*—Edmund J. Mills, D.Sc. (Lond.), F.R.S.

*Senior Assistant.*—Mr. J. B. Hannay, F.R.S.E.

*Junior Assistant.*—Mr. T. J. Allan.

This Chair has for its object the instruction of Students in Chemistry as applied to the various branches of industry in Chemical and other works, Metallurgy, Agriculture, &c.

LECTURES.—*Principal Course.*—A Course of Fifty Lectures will be delivered on Mondays, Tuesdays, and Wednesdays, at 9 a.m., commencing on November 6th. The Lectures will be illustrated with Experiments, Diagrams, and Models, as well as by the actual Inspection of Manufacturing Processes; and the progress of the Students will be tested by periodical Examinations. The earlier Lectures will have reference to units of weight and measure, to the calculations necessitated by Chemical operations, and to the nature and laws both of the Chemical process and its results. A particular subject will then be considered in comparatively minute detail.

Fee for the Course, Two Guineas. Admission free to Laboratory Students.

*Subsidiary Course.*—A Course of Thirty Lectures will be delivered on Mondays, Tuesdays, and Wednesdays, at 9 a.m., commencing on May 1st. These Lectures are more particularly intended for Dyers, Colour Manufacturers, Brewers and Distillers, Tar Rectifiers, Drysalts, and others interested in a knowledge of Technical Organic Chemistry.

Fee for the Course, Two Guineas.

*Laboratories.*—The Laboratories are open daily from 10 to 4, and on Saturday from 10 to 1 o'clock for practical

working by the Students, under the superintendence of the Professor and his Assistants.

The Fee for attending the Laboratories is £18 per Session of Nine Months, £13 for Six Months, £7 for Three Months, or £2 10s. per Month. Students are supplied with a working table containing the ordinary reagents required for analysis, and such apparatus as retort-stands, gas jets, &c. Small articles—such as Berlin porcelain, evaporating basins, funnels, retorts, flasks, beakers, &c.—Students are required to provide for themselves. Larger and more expensive apparatus—such as large evaporating basins, retorts, flasks, bottles, funnels, thermometers, &c.—are lent for experiments. Students must have a fair acquaintance with elementary Chemistry.

#### *Memorandum as to Bursaries.*

The Trustees of the "Young" Chair have the superintendence of the Bursaries—regulating the appointment and terms on which they shall be held.

The Nominees of Donors to be appointed if they pass the necessary examinations.

The Bursaries are of the amount of £50 each per annum, tenable for three years, during which the Bursars shall be required to give their whole time and attention to the Lectures and Laboratory duties of the "Young" Chair, paying the ordinary fees. Candidates to have attained sixteen years of age on application, to be of good moral character, and to pass such examinations as may be prescribed by the Trustees in the ordinary branches of an English education and the elementary principles of Chemistry. The Bursaries to be liable to forfeiture on the Bursars failing to exhibit approved progress under the Professor of the Chair, or being guilty of conduct, in the opinion of the Trustees, unworthy of their position. The Bursaries are only given to those whose means are limited, and who intend following some branch of Manufacturing Chemistry.

#### CHEMICAL LECTURES, CLASSES, AND LABORATORY INSTRUCTION.

BERNERS COLLEGE OF CHEMISTRY AND THE EXPERIMENTAL SCIENCES, 44, Berners Street, W.—Prof. E. V. Gardner, F.A.S., M.S.A. The Laboratory is open morning and evening throughout the year.

BIRKBECK LITERARY AND SCIENTIFIC INSTITUTION.—Mr. Henry C. Jones, F.C.S. A course of thirty Elementary Lectures on Organic Chemistry, on Tuesday Evenings. Begin Oct. 2.

NEW CENTRAL SCHOOL OF CHEMISTRY AND PHARMACY, 173, Marylebone Road, London.—Chemistry and Physics, Mr. A. P. Luff, F.C.S., Pereira Medallist, &c.; Pharmacy, Botany, Materia Medica, &c., Mr. J. Woodland, M.P.S.

ROYAL POLYTECHNIC COLLEGE.—The Annual Course consists of three terms, each averaging ten Experimental Lectures. 7.30 p.m. Fee 6s. per term, Session 15s. Practical Chemistry; fee, 12s. per term.

ROYAL VETERINARY COLLEGE, Camden Town.—Professor of Chemistry, Mr. R. V. Tuson.

WORKING MEN'S COLLEGE, 91, Blackfriars' Road.—Teacher of Chemistry, Mr. J. D. Allen.

SCHOOL OF PHARMACY OF THE PHARMACEUTICAL SOCIETY OF GREAT BRITAIN, 17, Bloomsbury Square.—The school opens on Monday, the 1st of October. Lectures on Chemistry and Pharmacy, by Professor Redwood, on Monday, Tuesday, and Wednesday mornings, at 9 a.m. The Laboratories for Practical Instruction in Chemistry as applied to Pharmacy, &c., under the direction of Prof. Attfield, will be open daily at 10 a.m. throughout the Session. The object of the founders of the Pharmaceutical Society of Great Britain in promoting a School of Pharmacy was to provide sound instruction, not in the practice of Pharmacy, but in the principles on which the

practice of Pharmacy should be based. They therefore, in the year 1842, instituted lectures on Chemistry, Chemical Physics, Pharmacy, Botany, and Materia Medica; and in 1844 added a Laboratory for instruction in Practical Chemistry. Such a curriculum provides a sound course of instruction in the respective subjects, and such, the Professors would add, is the only kind of scholastic or collegiate course of instruction which the Pharmaceutical Society or the Provincial Pharmaceutical Associations have instituted. In the shop or dispensary only should "Prescriptions" and "Practical Dispensing" be studied. These subjects should find no place in a true school of pharmacy, which, in teaching the principles on which the practice of pharmacy is based, seeks only to supplement and strengthen, not supplant, the practical teaching of the shop. The Professors strongly advise all learners, both before and during attendance at the school, to avoid studying merely by way of "preparation for examination." For "examination" even by the most highly skilled "Board," with ample time at its disposal and a wide area from which to select questions, is admitted by all authorities on education, whether statesmen, teachers, or examiners, to be but a partial test of knowledge and an extremely imperfect test of education. The student who only seeks the kind of information which will enable him to pass an examination mistakes the means for the end. So far from examination being the end and knowledge the means by which that end is accomplished, knowledge should be the end in view, and examination be regarded as a rough and partial test of the extent to which knowledge has been obtained. Not alone the knowledge which can be tested by examination, but that which cannot be so gauged, should, in all honour and in the highest self-interest, be the knowledge ever assiduously sought. The desire should not be for knowledge which, wanted only for the temporary purpose of examination, is rapidly gained and as rapidly lost, but for knowledge which will last. In short, the one desire should be *education*, that is knowledge accompanied by enlightenment of the understanding, mental training, mental discipline, and general elevation of the intellect. As for "examination," students of the School may rest assured that if they, guided by the Professors, work diligently, thoughtfully, deliberately, and thoroughly, they will with ease and pleasure pass any examination in the subjects in which they have thus been truly educated.

**Council Prizes.**—At the end of each of the five months' Courses of Lectures on Chemistry and Pharmacy, and Botany and Materia Medica, a Bronze Medal and Certificates of Merit, and at the close of the Session (ten months) a Silver Medal and Certificates of Honour and Merit, are offered for competition by the Council. In the Class of Practical Chemistry, the Silver Medal, two Bronze Medals, and Certificates of Honour and Merit, offered by the Council, are competed for at the end of the Session only.

**SOUTH LONDON SCHOOL OF CHEMISTRY**, 325, Kennington Road.—Dr. John Muter, F.C.S. Daily, at 10 a.m. Sixty Lectures on Theoretical Chemistry, and Junior and Senior Course of Practical Chemistry.

**BIRMINGHAM.—MIDLAND INSTITUTE.**—Mr. C. J. Woodward, B.Sc. Tuesday and Thursday, at 8 p.m.; Friday, at 7; and Saturday, at 3.

**BIRMINGHAM.—QUEEN'S COLLEGE.**—A. C. Bruce, M.A.

**BRISTOL MEDICAL SCHOOL.**—Mr. T. Coomber, F.C.S.

**LIVERPOOL ROYAL INFIRMARY SCHOOL OF MEDICINE.**

—J. Campbell Brown, D.Sc. Lond., F.C.S.

**SCHOOL OF TECHNICAL CHEMISTRY**, 7 and 9, Hackin's Hey, Liverpool.—Mr. A. Norman Tate.

**COLLEGE OF CHEMISTRY, LIVERPOOL**—Mr. S. H. Johnson, F.C.S.

**LEEDS MECHANICS' INSTITUTION.**—Mr. G. Ward, F.C.S.

**MANCHESTER GRAMMAR SCHOOL.**—Mr. Francis Jones, F.C.S., F.R.S.E.

**MANCHESTER MECHANICS' INSTITUTION.**—Mr. M. A. Watts, M.A.

CHEMICAL LECTURES AT LONDON HOSPITALS.

Chemical Schools and Colleges.	WINTER SESSION.				SUMMER SESSION.			
	Lecturers on Chemistry.	Days and Hours.	Fees.		Lecturers on Chemistry.	Days and Hours.	Fees.	
			One Course.	Perpetual.			One Course.	Perpetual.
St. Bartholomew's Hosp. and College .. .. .	Dr. Russell, F.R.S.	M. W. F., 9	£ 5	7	Dr. Russell	M. Tu. F., 11 [to 1	£ 2	3
Charing Cross Hospital and College .. .. .	Mr. Heaton	M. W. F., 11	5	7	Mr. Heaton	M. F.	2	2
St. George's Hospital ..	Mr. Wanklyn	Tu. Th. S., 11½	6	8	Mr. Wanklyn	Daily, 10	4	4
Guy's Hospital .. ..	Dr. Debus, F.R.S., and Dr. Stevenson	Tu. Th. S., 11	5	5	Dr. Debus	M. W. F., 10 to 1	4	4
King's College and Hosp.	Mr. Bloxam, F.C.S., Mr. Hartley, and Mr. Thomson	Th. S., 10½	7	10	Mr. Bloxam and Mr. Hartley, & Mr. Thomson	M. W. F., 10½	5	8
London Hospital .. ..	Dr. Tidy	M. Tu. W. Th., 11	7	7	Dr. Tidy	M. Th. S., 9	2	2
St. Mary's Hospital ..	Dr. Wright	M. W. Th., 4	4	6	Dr. Wright	Tu. F. S.	3	3
Middlesex Hospital ..	Mr. W. Foster	M. W. Th. Fr., 9	6	8	Mr. W. Foster	M. W. F., 3	3	3
St. Thomas's Hosp. & Schl.	Dr. Bernays	Tu. Th. F., 10	7	9	Dr. Bernays	M. Th. F., 10	4	7
University Col. & Hosp.	Dr. Williamson, F.R.S., and Dr. Graham	Daily (ex. S.) 11	7	9	Dr. Williamson & Dr. Graham	Daily (ex. S.) 11	4	7
Westminster Hospital ..	Dr. Dupré, F.R.S.	W. Th. F., 3	5	5	Dr. A. Dupré	M. W. F., 10	3	3

**QUEENWOOD COLLEGE**, near Stockbridge, Hants.—Mr E. W. Prevost, Ph.D., F.C.S., F.R.S.E.

**SHEFFIELD BOROUGH ANALYSTS' LABORATORY**, 1 and 3, Surrey Street.—Mr. A. H. Allen, F.C.S. Day and Evening Classes.

**SHEFFIELD SCHOOL OF MEDICINE.**—Mr. A. H. Allen, F.C.S. A course of forty-five Lectures on Inorganic and Organic Chemistry is delivered by Mr. Alfred H. Allen during the Winter session. The Summer Course of Practical Chemistry is under the direction of Mr. A. H. Allen.

**UNIVERSITY OF ABERDEEN.**—Prof. J. S. Brazier.

**ABERDEEN SCHOOL OF SCIENCE AND ART MECHANICS' INSTITUTION.**—Mr. Thomas Jamieson, F.C.S.

DUNDEE LITERARY INSTITUTION CHEMICAL LABORATORY.—Classes in Practical Sciences daily. Lecturer on Chemistry and Physics, Mr. Frank W. Young, F.C.S.

UNIVERSITY OF EDINBURGH.—Prof. A. Crum Brown, F.R.S.E.

SCHOOL OF MEDICINE, EDINBURGH.—Dr. Stevenson Macadam, F.R.S.E., Mr. Falconer King, and Mr. Ivison Macadam.

GLASGOW UNIVERSITY.—Prof. J. Ferguson.

GLASGOW MECHANICS' INSTITUTION.—Mr. R. R. Tatlock, F.R.S.E., F.C.S.

GLASGOW VETERINARY COLLEGE.—Mr. Stephen Cooke, F.C.S.

SCHOOL OF CHEMISTRY, 138, Bath Street, Glasgow.—Dr. Wallace, Mr. Tatlock, and Dr. Clark. Day and Evening Classes.

CHEMICAL LABORATORY, 144, West Regent Street, Glasgow.—Dr. Milne. Day and Evening Classes.

ANALYTICAL LABORATORY, 88, Hope Street, Glasgow.—Dr. A. T. Machattie, F.C.S. Day and Evening Classes.

QUEEN'S COLLEGE, BELFAST.—Dr. Andrews, F.R.S., &c.

QUEEN'S COLLEGE, CORK.—Dr. Maxwell Simpson.

QUEEN'S COLLEGE, GALWAY.—Dr. T. H. Rowney.

ROYAL COLLEGE OF SURGEONS IN IRELAND.—Dr. C. A. Cameron.

DUBLIN, CARMICHAEL SCHOOL.—Dr. C. R. C. Tichborne.

DUBLIN, CATHOLIC UNIVERSITY.—Mr. Campbell.

DUBLIN, DR. STEEVENS'S HOSPITAL AND MEDICAL COLLEGE.—Mr. McHugh.

## ON THE COMPOSITION OF FERRIC PHOSPHATE.

By G. W. WAINE.

It appears to be generally believed that the precipitate formed by the reaction between ferric chloride and ordinary phosphate of sodium varies in composition accordingly as either salt is in excess. To ascertain if this be true, I prepared some pure crystallised ferric chloride ( $\text{Fe}_2\text{Cl}_6$ ). I found some difficulty in obtaining this free from ferrous chloride, which is always present in the product of the action of chlorine upon heated iron wire, even though the former is employed in large excess. The chlorination could be completed only by keeping the crystals of ferric chloride in a bottle of chlorine gas freely exposed to light.

Standard solutions of this and hydro-disodic phosphate ( $\text{Na}_2\text{HPO}_4$ ) having been prepared, two samples of the ferric phosphate were made:—

A. By adding the ferric chloride to sodium phosphate in excess with constant stirring.

B. By adding sodium phosphate to ferric chloride.

It was found that the precipitates could not be washed by decantation, for they would not subside properly, and easily passed through the pores of a filter; so they were transferred to dialysers of parchment-paper, which were suspended over large volumes of distilled water, renewed in a day or two, when it contained much salt. This was found to be a perfect method of washing the gelatinous precipitates, and it is probably to the want of such a method at an earlier date that we must ascribe the discrepancies in the results of different analyses of the ferric phosphate.

When completely washed, the precipitates were dried and ignited. The process first adopted for determining their composition consisted in dissolving them in hydrochloric acid, and determining the iron by means of a standard solution of potassium permanganate, after reduction to the ferrous state by means of sodium sulphite. Five determinations made in this way gave as a mean result:—

For A (prepared by adding  $\text{Fe}_2\text{Cl}_6$  to  $\text{Na}_2\text{HPO}_4$ ), 38.01 per cent iron.

For B (prepared by adding  $\text{Na}_2\text{HPO}_4$  to  $\text{Fe}_2\text{Cl}_6$ ), 38.63 per cent iron.

This would give, for one molecule of  $\text{PO}_4$  (= 95) in A 1.04 as the atomic proportion of Fe (= 56); in B, 1.06. Whence it appears that the precipitate is essentially  $\text{FePO}_4$ , but that it has a tendency to contain a slight excess of iron, especially when precipitated in the presence of an excess of ferric chloride.

In the course of these analyses I noticed that the number of divisions of the permanganate solution required in successive determinations did not agree so closely as is usual in the volumetric estimation of iron, evidently in consequence of a difficulty in ensuring the complete reduction of the ferric phosphate to the ferrous state.

Some more analyses were then made, in which the phosphoric acid was estimated by adding to the hydrochloric solution some citric acid, then ammonia in excess and ammonium sulphide, boiling, filtering, and precipitating the phosphoric acid as magnesium-ammonium-phosphate.

Two analyses of each sample gave, for one atom (56) of iron:—

	A.	B.
I.	1.004 mol. $\text{PO}_4$	0.91 mol. $\text{PO}_4$
II.	0.97 „	0.95

When the precipitated ferric phosphate was exposed to air dried by sulphuric acid until its weight was constant, it was found to contain 2.65 molecules of water for each atom of iron present; this water was not entirely expelled at  $250^\circ\text{C}$ . The precipitate appears, therefore, to be represented by the formula  $2\text{FePO}_4 \cdot 5\text{H}_2\text{O}$ .

I have endeavoured to determine phosphoric acid volumetrically by mixing the solution with potassium iodide and starch, and adding a standard solution of ferric chloride until an excess was indicated by the liberation of iodine; but I found that the mixture of potassium iodide and starch was far less sensitive to the action of ferric chloride than to that of chlorine, so that it was possible for iodide of potassium and ferric chloride to coexist in the solution for some minutes. In attempting to use potassium sulphocyanide to indicate the excess of ferric chloride, I found that the delicacy of the reaction was seriously impaired when acetic acid was present, a condition which would of necessity exist in most determinations of phosphoric acid for practical purposes.

## SCHEEL'S GREEN.

By S. P. SHARPLES, S.B.

A CURIOUS error in regard to this salt has found its way into many of the text-books. Watts, in his Dictionary, states that it is dissolved by an excess of ammonia without colour. In this he is supported by Graham Otto (last edition) and the Handwörterbuch.

This evidently arises from a misunderstanding of Berzelius's\* description of this substance. After describing the preparation of arsenite of copper by means of arsenious acid and the carbonate of copper, he goes on to say:—

A neutral combination is obtained, when sulphate of copper is precipitated by means of arsenite of potassium. The precipitate is green. When the alkali is in excess, the colour is brightened; but it decomposes spontaneously after a time and becomes dark-brown, and contains cupric arsenate and cupreous arsenite. This salt is dissolved by ammonia to a colourless liquid, which most likely contains cupreous arsenate.

"This salt" in the above sentence evidently refers not

\* Wöhler's Trans., 1838.

to the green salt, but to the brown. That this view is correct is confirmed by numerous experiments I have made upon the subject, and by the following description, which is found in Rosé's "Qualitative Chemistry," Paris, 1859, p. 384. Speaking of Scheele's green, the author says:—"This precipitate is soluble in an excess of ammonia, and also in an excess of hydrate of potassa; the solution in both cases is of almost the same blue colour. The blue solution formed by the potash deposits after a time reddish-brown suboxide of copper. The liquid becomes colourless, and contains potassium arsenate. The blue solution formed by ammonia is not modified by time." To this I will add that ammonia does not decompose Scheele's green by prolonged boiling; the copper may, however, be completely precipitated as suboxide by the addition of potassa to the ammoniacal solution.—*American Chemist*.

ON A  
NEW METHOD OF DETERMINING  
PHOSPHORUS, ARSENIC, SULPHUR, CHLORINE,  
BROMINE, AND IODINE IN ORGANIC  
SUBSTANCES.

By M. G. BRUGELMANN.

THE method proposed by the author consists in burning the organic matter in a current of oxygen and in condensing the products by an incandescent layer of pure lime, or of soda lime, in the case of the determination of bromine and iodine. We operate in a tube of Bohemian glass open at both ends, of an internal diameter of 12 m.m. Here are introduced successively—First, a leaf of platinum of the width of 2 centimetres, rolled in a spiral, and forming a plug. Second, a layer of lime in granules, or soda lime, which is heaped lightly so that it may occupy all the diameter of the tube; a length of 10 centimetres is given to this layer, which is quite sufficient to retain completely the elements to be determined. Third, a second leaf of platinum of a width of 5 centimetres rolled into a spiral; when the body in question contains phosphorus or arsenic, this spiral should be replaced by a layer of fragments of very small infusible glass. Fourth, a layer of asbestos of a length of 15 centimetres; this layer is indispensable to prevent explosions when we are operating upon volatile bodies or on substances emitting at a temperature slightly elevated combustible gases or vapours. Fifth, the substance introduced directly into the tube, or contained in a small boat or vial may be in large pieces. Finally, the tube is closed by a stopper holding a very narrow tube (diameter 0.5 m.m.), through which the oxygen is transmitted; the extremity of the tube remains open. The total length of the tube is from 40 to 50 centimetres. We commence by heating the first half of the layer of lime, then oxygen is caused to enter, whilst the other half is raised to redness; at this moment we commence the combustion of the substance. The oxygen ought always to be in excess in the tube, so that the products arriving on the lime are entirely burnt; in any case the lime should not blacken. The speed of the current of oxygen is liable to variations, but on the average 100 c.c. may enter per minute.

If we burn volatile matters or substances which are decomposed at a low temperature, giving off vapours, we cannot always prevent explosions, even on heating with great precaution; in this case we commence the combustion in a current of air, and only turn on oxygen at the moment when we have driven by heat all the substance into the layer of asbestos. Substances rich in phosphorus are mixed with three times their weight of lime and placed in a large platinum boat. When the combustion is finished we break the tube at the place where the layer of asbestos touches the platinum spiral, we remove with care the smallest particles of asbestos, we clean the out-

side of the tube, and we heat the contents with water to clean it completely; then we add gradually nitric acid until the whole is in solution; in this way we only employ a slight excess of nitric acid. It is well understood that the tube and boat ought to be rinsed carefully in weak nitric acid. In this solution the haloid elements are precipitated in the state of chloride, bromide, or iodide of silver, where they are determined volumetrically by Volhard's process by means of two standard solutions of sulphocyanide of ammonium and nitrate of silver, ferric sulphate serving as an indicator. Let us add, however, that a part of the iodine is found in the state of free iodine and of iodic acid, and ought to be brought back previously to the state of hydriodic acid by the addition of sulphurous acid until the liquid is decolourised.

Sulphuric acid is determined as sulphate of barium, or else volumetrically by a standard solution of chloride of barium, after the method of Wildenstein, which the author has modified slightly. Finally, the phosphoric or arsenic acids are volumetrically determined with nitrate of uranium. The lime and soda-lime are employed in the form of grains whose diameter exceeds 1 millimetre; they ought to be free from chlorine, sulphur, phosphorus, iron, and aluminum. The author describes the preparation of pure lime and soda-lime; for this latter he employs 4 parts of pure lime and 1 part of pure soda prepared from sodium.

The method seems to us to present a great interest for determining chlorine, sulphur, or phosphorus in substances which are poor in these elements, such as vegetable and animal products; it enables us, in fact, to burn in a short time a large quantity of matter (about 20 grms. in two hours).—*Zeitschrift für Analytische Chemie*, xv., and xvi., 1.

SCHÆNBEIN'S TEST FOR NITRATES.

By F. H. STORER,

(Concluded from p 117.)

THE defect of the usual method of testing for nitrates having been made apparent, I have naturally endeavoured to discover some better method of procedure which, while preserving all the delicacy of the test, should permit its general application. Casting about for some means of reducing nitrates to nitrites which should not at the same time occasion the formation of peroxide of hydrogen, I have finally hit upon the simple device of boiling the nitrate with metallic cadmium in water that is slightly acidulated, instead of operating with neutral solutions, as has hitherto been recommended. Contrary to what might have been inferred from what has been published hitherto, and from what is known of the action of acidulated water upon metals in the cold, no peroxide of hydrogen is formed when water slightly acidulated with sulphuric acid is boiled upon metallic cadmium; and since the reduction of nitrates to nitrites by means of cadmium occurs readily in such boiling acidulated solutions it happens that the iodo-starch test can be employed in this way for the detection of nitrates without difficulty and with a high degree of certainty. The only special precautions to be taken are to test the boiled liquid with litmus paper in order to be sure of its acidity, and to guard against the loss of any nitrous acid by volatilisation. This can readily be done by attaching to the small flask in which the nitrate is reduced a small inverted Liebig's condenser, through the sleeve of which a stream of cold water is made to flow. The following experiments will illustrate the delicacy of this new method of testing:

A. 0.0005 grm.  $N_2O_5$ , in the form of nitrate of potash, was boiled for five minutes upon metallic cadmium in 50 c.c. of pure water to which two drops of the dilute sulphuric acid (see note on p. 117) had been added. On testing

with iodo-zinc-starch plus acid a strong reaction was obtained, almost immediately.

B. 0.0002 gm.  $N_2O_5$  similarly treated gave a reaction in about five minutes.

C. 0.0001 gm.  $N_2O_5$  gave a reaction in rather less than fifteen minutes.

D. 50 c.c. of pure water acidulated with two drops of the dilute sulphuric acid, and boiled upon cadmium, without any addition of a nitrate, gave no reaction with iodo-zinc-starch plus acid, not even on standing over night.

Repetitions of these trials gave results that were identical with the foregoing.

E. 0.00005 gm.  $N_2O_5$  in 50 c.c. of pure water was tested, as above, in comparison with pure water devoid of nitrate. At the end of half an hour the solution that had contained the nitrate gave a rather strong colouration with the iodo-starch, while the pure water remained perfectly colourless.

F. 0.00001 gm.  $N_2O_5$  in 50 c.c. water was tested as above. But no reaction was obtained with the iodo-starch, not even after the lapse of 36 hours.

G. In order to determine whether metallic cadmium in acidulated water actually destroys peroxide of hydrogen at the temperature of boiling, 100 c.c. of pure water were boiled upon cadmium and left to stand in contact with the metal over night; the water thus charged with peroxide was divided into two equal portions, one of which was tested directly with iodo-starch plus acid, while the other was acidulated with two drops of dilute sulphuric acid, again boiled upon cadmium, and then tested. A strong reaction was obtained in the portion tested directly, but no reaction was obtained from the acidulated portion until after the lapse of two hours, and then the colouration was but slight. In repeating this experiment, 100 c.c. of pure water were boiled upon cadmium for five minutes; 50 c.c. of the water were then poured off to be tested, while two drops of dilute sulphuric acid were added to the flask, and the acidulated liquid was again boiled for five minutes with the cadmium. On decanting and testing the acidulated liquid with iodo-starch, it gave no colouration, not even after the mixture had stood over night, while on testing the portion that had been boiled without acid it gave a strong colouration in due course.

H. To see if hydrogen alone would so quickly destroy the peroxide, a stream of hydrogen gas was made to flow during five minutes through a solution of peroxide of hydrogen, prepared as above, that was kept at a temperature of boiling. But the liquid thus treated gave almost as strong a reaction with iodo-starch after the passage of the hydrogen as it had done before.

On trying whether some one of the more common metals might not perhaps be used in testing for nitrates by the new method, it appeared that neither of them is on the whole so well fitted for the purpose as cadmium. Thus on repeating the foregoing experiments, with zinc, amalgamated zinc, aluminum, and iron, it appeared that while no peroxide of hydrogen was formed on boiling acidulated water upon these metals, neither of them was so well fitted as cadmium to reduce nitrates to nitrites in acidulated solutions. From zinc and from amalgamated zinc, distinct reactions were obtained with solutions containing 0.0005 gm.  $N_2O_5$  in 50 c.c. water, when the iodo-starch mixture was left to stand over night, though no colouration appeared until after the lapse of more than two hours; slight reactions were obtained also, after long standing, from solutions that contained 0.0001 gm.  $N_2O_5$ ; but no reaction was obtained in a solution that contained 0.00005 gm.  $N_2O_5$ . From aluminum a slight colouration of the iodo-starch was obtained, after two hours standing, with a solution that contained 0.01 gm.  $N_2O_5$  in 100 c.c. water, and a stronger reaction was got from a solution that contained more of the nitrate. From iron no reaction was obtained in the course of two hours with a solution containing 0.01 gm.  $N_2O_5$  in 100 c.c. water, though with a considerably stronger solution a reaction was ob-

tained. A solution containing 0.01 gm.  $N_2O_5$  in 100 c.c. water boiled upon a mixture of iron and platinum gave a reaction almost immediately, but one containing 0.001 gm.  $N_2O_5$  gave no reaction after having been boiled upon the mixed iron and platinum. No reaction was obtained with a solution containing 0.01 gm.  $N_2O_5$  in 100 c.c. water after adding to it a small quantity of acidulated sulphate of silver and boiling the mixture upon iron.

Both lead and magnesium easily reduce nitrates to nitrites in acidulated solutions, magnesium perhaps even more readily than cadmium, but neither of them would seem to be so good as cadmium for use in testing for nitrates, since they form peroxide of hydrogen when boiled in water that is no more strongly acidulated than that just described. The trouble with both metals, but particularly with magnesium, seems to be that they combine with and consume the acid too rapidly, so that the solution becomes neutral or well nigh neutral, and fit for the production of peroxide of hydrogen, before the boiling process is finished.

In experiments with lead it was found that a solution containing 0.0001 gm.  $N_2O_5$  in 50 c.c. gave a decided reaction with iodo-starch in less than half an hour, and that a solution containing 0.00005 gm.  $N_2O_5$  gave a distinct reaction in half an hour, though it was not quite as strong as the reaction obtained with cadmium under similar circumstances. 50 c.c. pure water plus two drops dilute sulphuric acid, boiled five minutes upon lead without the addition of any nitrate gave a slight reaction with iodo-starch and acid on standing over night; but on repeating the experiment with four drops of acid no reaction was obtained.

In experiments with magnesium it was found that nitrate solutions containing respectively 0.0001 and 0.00005 gm.  $N_2O_5$  in 50 c.c. water gave reactions with acidulated iodo-starch within fifteen minutes; and that a solution containing 0.00001 gm.  $N_2O_5$  plus four drops of acid gave a distinct reaction on standing over night. But 50 c.c. pure water plus two drops dilute sulphuric acid boiled five minutes upon magnesium without addition of any nitrate gave a slight reaction in the course of two hours, and on repeating the experiment, with four drops of acid a slight reaction was obtained on leaving the mixture to stand over night, though none was visible at the end of two hours. With silver, an acidulated solution containing 0.025 gm.  $N_2O_5$  in 50 c.c. water gave a very slight reaction with iodo-starch in the course of two hours, while a weaker neutral solution, containing 0.01 gm.  $N_2O_5$  in 100 c.c. water that was boiled upon silver gave no reaction.

It is to be observed that in the foregoing set of experiments the solutions were acidulated in every instance before the boiling, and that an inverted condenser was always attached to the flask in order to prevent the escape of any nitrous acid.

Solutions containing 0.005 gm.  $N_2O_5$  in 50 c.c. acidulated water, left in contact for eight hours or more in the cold with metallic aluminum, iron, or zinc, and then tested with iodo-starch gave no reaction in the cases of iron and zinc, and only a slight colouration in the case of aluminum.

No reaction for peroxide of hydrogen was obtained in acidulated water that had been boiled five minutes upon a mixture of pieces of tin and platinum, nor was any reaction obtained from an acidulated solution of nitrate of potash that had been similarly boiled.

Numerous trials were made to discover, if possible, some reducing agent which, though proper to change nitrates to nitrites in neutral solutions, should not form peroxide of hydrogen in such solutions; but all these efforts were unsuccessful. In point of fact there are comparatively few chemicals capable of reducing nitrates to nitrites in presence of much water; while most, if not all, of these substances readily form peroxide of hydrogen

when left in contact with water and air. Among metals\* I have found only iron and lead that seem to be at all fit to be used as substitutes for cadmium or zinc, in testing for nitrates by the old method. Both these metals readily reduce nitrates to nitrites in dilute neutral solutions at the boiling temperature; but they, as well as magnesium, aluminum, and copper,† cause the formation of peroxide of hydrogen also, when boiled in pure water. Aluminum, though it reduces nitrates to nitrites in neutral solutions, seems to be inferior to zinc for this purpose, and magnesium, though it reduces nitrates very readily in neutral solutions, seems to form peroxide of hydrogen even more easily than cadmium.

The behaviour of iron and lead towards nitrates will appear from the following statement: Neutral solutions of nitrate of potash, containing 100 c.c. of water, 0.01 gm. (or more) of  $N_2O_5$ , gave a strong reaction with the iodo-starch, after having been boiled five minutes upon iron wire; with 0.001 gm.  $N_2O_5$  the reaction soon appeared, and with 0.0001 gm.  $N_2O_5$  the reaction appeared after some little time. A special experiment was made as follows to test the efficiency of iron as compared with that of cadmium or zinc: 50 c.c. of pure water were boiled for five minutes upon iron wire in one flask, while in another flask 50 c.c. of pure water, plus 0.0005 gm.  $N_2O_5$ , in the form of nitrate of potash, were boiled upon an equal amount of the iron wire. When cold, the liquids were transferred to porcelain capsules, mixed with iodo-zinc-starch and acid, and left to stand over night. Decided reactions were obtained in both instances, but the liquid to which the nitrate had been added was deeper coloured than the other, and the difference in tint between the contents of the two dishes seemed to be rather more marked than was the case in similar experiments where cadmium or zinc had been used instead of iron. It is not unlikely that iron would have been rather better fitted than either of these metals for use in testing for nitrates according to the old plan.

On repeating this last experiment with metallic lead, instead of iron, decided reactions were obtained with the iodo-starch in both dishes; but the colourations were of about the same depth as those ordinarily obtained with cadmium, and that obtained from the nitrate solution was no stronger than that from the pure water.

Solutions of nitrate of potash (0.01 gm.  $N_2O_5$  to 100 c.c. water), made alkaline with potash or with lime, were reduced, with formation of nitrite, when boiled for five minutes upon iron, or left to stand over night in contact with the metal in the cold; but the reactions with iodo-starch that were obtained in this way were less strong than those got by operating upon neutral solutions of the nitrate.

The following substances failed to reduce nitrate of potash when boiled for five minutes with neutral solutions of that substance, containing 0.025 gm.  $N_2O_5$  in 100 c.c. water, or, at the least, no reaction could be obtained with the iodo-starch after using them, viz.: filter-paper, phosphorus (ordinary and amorphous), arsenic, ferrous sulphate, ferrous sulphide, and sulphite of lead. No reaction was obtained when acidulated solutions of the nitrate, of the above-mentioned strength, were boiled with stannous

chloride, ferrous sulphate, glucose, or arsenic. No reduction to nitrite was detected when solutions of the nitrate that had been mixed with lime were digested with ordinary or amorphous phosphorus, glucose, or ferrous sulphide, or when a solution that had been mixed with hydrate of potash was boiled upon metallic arsenic.

On the other hand, recently precipitated cupreous oxide, boiled for five minutes with neutral acid, and alkaline solutions of nitrate of potash (0.01  $N_2O_5$  in 100 c.c. water), reduced some of the nitrate in each instance, so that reactions were obtained on adding iodo-starch to the several filtrates, but as the reactions were not very strong there seemed to be little encouragement to proceed with the inquiry.

If it were less difficult than it is to manipulate with thoroughly boiled water so that no atmospheric air should come into contact with it, it would be possible, by using such water, to avoid the interference of peroxide of hydrogen in testing for nitrates in neutral solutions by Schœnbein's process; for, out of contact with the air, no peroxide of hydrogen is formed by the action of cadmium or zinc upon water that has been thoroughly boiled, in a glass flask provided with a long and very narrow outlet. Even when no special pains are taken to preserve such water from contact with the atmosphere after the boiling, it is easy to perceive that peroxide of hydrogen does not readily form in it. So, too, though in a lesser degree, with water that has been well nigh completely deprived of air by distillation in the vacuum of an air-pump. But no such inability to yield peroxide of hydrogen was observed in water that had been boiled for a long time in a copper flask, into the neck of which a long and very narrow brass tube had been soldered. The boiled water from the copper flask gave a reaction for the peroxide even when tested directly, without having been put in contact with any other metal.

I am much indebted to my assistant, Mr. D. S. Lewis, for his co-operation in this investigation.—*American Journal of Science and Arts*.

Bussey Institution, Jamaica Plain, Mass.

## REPORT

ON THE

## DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.\*

By Dr. A. W. HOFMANN.

(Continued from p. 95.)

*Manufacture of Sulphuric Acid.* By ROBERT HASEN-CLEVER, Manager of the Stolberg Works.

If the Rhenania Chemical Works was willing to sell its two platinum vessels, one of which has been procured only a few years ago, while the other has been in use for twenty-one years, and has undergone repeated repairs at the price of 810 francs per kilo., the account would show a consumption of 0.972 gm. of platinum per 1000 kilos. of sulphuric acid, or an outlay on platinum equal to 1.616 franc, or 1.29 mark (not quite 1.3d.) per 1000 kilos. of acid at that strength.†

\* I have, as yet, made no experiments with the alkali metals or their amalgams.

† And various other metals, as recorded in Gmelin Kraut's "Handbuch," i. (2 Abth.), p. 56.

Since the above statement, that iron forms peroxide of hydrogen on being boiled with water in contact with air, may seem to conflict with Schœnbein's observation that the peroxide is not formed when iron is shaken in water and air, it may be well to give the evidence on which it depends. Pure water was boiled with iron wire for five minutes; the cold liquid was mixed with iodo-zinc-starch solution and dilute sulphuric acid, and left to stand over night. A purplish colouration was obtained. On repeating the experiment, a precisely similar reaction was observed. This colouration is rather less, it should be said, than that obtained from the other metals enumerated above; but is, nevertheless, perfectly distinct and characteristic. In still another experiment, where pure water was boiled upon sheet iron, no reaction for peroxide of hydrogen was obtained. The liquid assumed a rusty tint, and no blue colouration could be perceived.

\* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

† As regards the question what method of concentration is the more economical, the following information has been received by the editor from P. W. Hofmann, of Wöcklum. At Dieuze, where 2500 kilos. of sulphuric acid are daily concentrated to 66° B. in glass vessels, the cost per 1000 kilos. is as follows:—

Coal, 200 kilos. . . . .	4 marks
Labour . . . . .	3 "
Breakage . . . . .	1 "

If the precaution is observed of changing all the retorts every six weeks, whether damaged or not, breakage can be almost entirely avoided, and the cost for glass reduced to about 75-100th of a mark.—A. W. H.

In general the acid at Hautmont and at Stolberg was free from nitrogen compounds; if nitrous acid was found on testing with indigo a little ammonium sulphate was added to the acid in the lead pans, according to the suggestion of Pelouze.

The two firms who exhibited platinum stills at Vienna were Desmoutis, Quenessen, and Co., of Paris, and Johnson and Matthey, of London. The apparatus differ in certain details. The English firm employ double syphons and cooling worms, whilst the French make use of a long single syphon. The capital which conducts away the weak acid slopes towards the body in the English apparatus, whilst in the Parisian it is bent away in the opposite direction. The English arrangement by reason of its reflux yields less weak acid, but at the same time also a smaller quantity of concentrated acid than does the French.

The opinions of manufacturers concerning the stills of the two firms were upon the whole equally favourable. The English acid makers obtain their platinum stills for convenience sake generally from London, whilst many Continental manufacturers remain in connection with Desmoutis, Quenessen, and Co., on account of the rapidity of transport in case of repairs.

Both the stills exhibited in Vienna had a syphon of a new construction, one of whose legs, placed within the still, has a lateral aperture at the same level with the heating-flues. By means of this arrangement the acid in the apparatus can never fall below the level of the upper angle of the flue. The sheet platinum is therefore constantly covered by the liquid, whilst on the old principle the workman was not able to observe the level of the acid, and the syphon could run off the contents of the still to such an extent that the furnace-gases could play over and damage the dry metal.

The arrangement in the apparatus of Desmoutis, Quenessen, and Co. was proposed by the author.\* In order to prevent the evacuation of the apparatus below the desired level, the lateral orifice in the syphon is connected with an air-pipe, which plunges in from above. It is thus contrived that the syphon always draws off sulphuric acid from the deepest part of the apparatus, whilst a simple lateral orifice in the syphon, without a tube opening upwards, would during regular working produce an influx of sulphuric acid into the syphon at this place. To prevent the acid spirting out during boiling a funnel with a movable cover is fitted to the top of the air-pipe. If it is wished to empty the apparatus entirely, the aperture of the funnel is closed with a plug, which is not kept by the workman in charge.

In the arrangement adopted by Johnson and Matthey for the same purpose a reciprocating cock is introduced into the air-pipe above so as to allow the apparatus to be emptied. It is probable that the workman will generally close this cock, for when the syphon is run out he has the trouble of filling it again before resuming work. He operates then with an arrangement which acts exactly like a common syphon, as when the cock is shut the lateral orifice does not communicate with the atmosphere.

A. de Hemptinne† constructed an apparatus for concentrating sulphuric acid down to 1.84 specific gravity under reduced atmospheric pressure without the use of glass or platinum. The apparatus is said to be in operation near Brussels, but is little employed elsewhere.

Baist and Rössler, of the Greisheim Chemical Works, employ experimentally a modified platinum apparatus, as patented by Johnson and Matthey. In this arrangement only the lower part of the still which contains the acid, and is exposed to the furnace-gases, is made of platinum, the dome being constructed of lead. This apparatus does not cost half as much as an ordinary platinum still, but in practice it requires frequent repairs, since the lead is

heated too strongly from below, and is too heavily weighted above by the refrigerating liquid.

Faure and Kessler, sulphuric acid manufacturers at Clermont-Ferrand (Puy de Dome), have sought to improve the construction of the platinum and lead concentration apparatus. This process is described in a pamphlet, "Notice sur les Appareils à Cuvette pour la Concentration à 66° B. de l'Acide Sulphurique."

The acid is heated in a very flat platinum pan of about 70 centimetres diameter. Over this pan is a very roomy lead chest, in which is condensed the weak acid which distils over. This construction affords a greater prospect of durability than the dome resting directly upon the pan, and the apparatus is said, in fact, to be capable of working for months without repairs. The inventors give in their pamphlet a comparative scale of cost, and mention as the principal advantages the following:

1. Decrease of first cost in the proportion of 300 to 350 per cent (?).
2. No wear and tear of platinum.
3. Decrease of 90 per cent of the loss in case of accidental injury to the still.
4. Economy of fuel.
5. Reduction of labour to the extent of 30 to 60 per cent.
6. Total abolition of the stoneware jugs used for filling the apparatus, and consequently no loss from their breakage.
7. Freedom from danger.
8. Greater regularity.
9. Reduced wear and depreciation of platinum, one-twentieth of ordinary amount. (But see No. 2 above.)
10. Great convenience for repairs.

An apparatus of Faure and Kessler's, costing 15,000 francs, is said to yield in twenty-four hours about 2500 kilos. of sulphuric acid at 66° B. An apparatus of the same power, entirely of platinum, can be had from Desmoutis, Quenessen, and Co. for 30,000 francs, even if the platinum costs 1000 francs, and not for 45,000 francs as assumed in the pamphlet. The first cost, supposing Faure and Kessler's system to hold good is only reduced 50 per cent.

The advantages Nos. 2 to 10 cannot be taken into consideration: stoneware jugs can be dispensed with in an ordinary apparatus, and the depreciation of the platinum pan must be increased, since in the ordinary construction it is precisely the lower part which suffers, whilst the weight of the dome and syphon remains approximately constant.

Stolberg, February 1, 1874.

(To be continued.)

## CHRYSOLIN, A NEW YELLOW DYE DERIVED FROM RESORCIN.

By F. REVERDIN.

THE colouring matter of which we are about to speak, and which we have prepared since March this year at the works of MM. P. Monnet and Co. at Geneva, is formed by the simultaneous action of phthalic and sulphuric acid upon benzyl-resorcin.

Benzyl-resorcin is obtained very readily either by causing the chloride of benzyl to act upon resorcin in presence of a small quantity of zinc-powder, or by heating an alkaline and alcoholic solution of resorcin with chloride of benzyl, or, lastly, by heating, to about 150° in the oil-bath, a mixture of 1 molecule of resorcin and of 2 molecules of chloride of benzyl.

The most simple manner of preparation consists in adding the chloride of benzyl, little by little, to the melted resorcin; a large quantity of hydrochloric acid escapes, and the mass becomes a reddish-brown. When all the

\* R. Hasenclever, *Ber. Chem. Ges.*, vii., 502.

† A. de Hemptinne, *Dingler's Polyt. Journ.*, ccv., 419; *Wagner's Jahresberichte*, 1879, 243.

chloride of benzyl has been introduced it is heated to  $150^{\circ}$  in the oil-bath in a flask fitted with an ascending condenser until the escape of hydrochloric acid is at an end. The product of the reaction is poured into water, boiled to expel the last traces of chloride of benzyl, let settle, and decanted.

The compound thus obtained is a strongly-coloured oil, very thick, insoluble in water, in which it sinks; it distils at a very elevated temperature, with partial decomposition. It dissolves in alcohol with a yellow colour; the solution has a decided green fluorescence. Benzyl-resorcin is soluble also with a yellow colour in benzol, chloroform, and ether.

*Preparation of Chrysolin.*—The following method dispenses with the previous preparation of benzyl-resorcin:—We heat in the oil-bath to  $130^{\circ}$  to  $140^{\circ}$  in a retort of enamelled cast-iron—

Sulphuric acid .. .. 460 grms.  
Common phthalic acid .. 1 kilo.

The latter substance is transformed, in this operation, into phthalic anhydride. We then introduce into the retort:—

Resorcin .. .. 1 kilo.  
Sulphuric acid .. .. 460 grms.  
Chloride of benzyl .. .. 1 kilo.

and heat gently in the water-bath. The heat may be removed when hydrochloric acid begins to escape, and the reaction continues spontaneously. When no more hydrochloric acid is evolved, which may ensue in three or four hours, the reaction is completed by heating for twelve hours in the oil-bath to  $135^{\circ}$  to  $145^{\circ}$ . It is then let cool, the solid product of the reaction is broken up and dissolved in dilute caustic soda. It is well to boil for a considerable time. When the residue no longer diminishes in volume, we filter and precipitate the acid colouring matter by means of hydrochloric acid. The precipitate is washed with cold water, dissolved in the quantity of carbonate of soda needful to saturate the acid, and evaporated to dryness. The soda-salt of benzylated fluorescein constitutes chrysolin.

Chrysolin appears, as a mass, with green metallic reflections, but is red-brown when reduced to powder. It is soluble in water and alkalies; its solutions, which present a magnificent green fluorescence, are precipitated by acids in yellow flocks. It yields bromated, iodated, and nitro-derivatives, which are all beautiful colouring matters.

Chrysolin may be fixed directly upon silk and wool. Wool, however, is preferably mordanted in a beck of acetate of lead and alum. Cotton is mordanted with sulphate of alumina and dyed at a hand-heat.

The shade of chrysolin approaches that of turmeric, and it resists the action of light well.

Yellow colouring matters may also be obtained by replacing the chloride of benzyl with the chlorides, bromides, and iodides of the fatty series. Methyl-resorcin, prepared by heating under pressure the resorcinate of soda in alcoholic solution with chloride of methyl, yields also a yellow colouring matter.—*Moniteur Scientifique.*

## ON SCIENTIFIC RESEARCH IN RELATION TO TANNING.

By HENRY R. PROCTOR, F.C.S.

As I believe it is intended that this first meeting of our society\* should discuss the best means of stimulating scientific inquiry about leather-making, I venture to put down a few remarks on the subject, rather with the hope of raising discussion than because I suppose that individually I can throw any important light upon it.

It is scarcely necessary, in the present day, to insist on the importance of science to business in general; it will

be more to the point to particularise a few matters which specially claim attention in our own industry. Without doubt other members will add to the list of unsolved problems, and perhaps suggest lines of inquiry which are still more likely to be productive.

To begin at the beginning, we are far from knowing all about the softening of dried hides. The putrefying soaks which are used for the purpose must have an injurious effect on the fibre of the hide. By the addition of an antiseptic, such as carbolic acid, or some poisonous metallic salt to the water, this putrefaction might be checked, and the hides allowed to soak for much greater lengths of time without injury. It is doubtful, however, whether mere soaking without putrefaction will completely soften and swell the fibre, and by no process that I know can dried hides be completely restored to their natural plumpness. The green hide contains, between the gelatinous fibres, a glutinous liquid, like white of egg, which, on drying, sticks them together into a compact mass, and is very likely insoluble in cold water alone, while it is probably easily destroyed by putrefaction. Chemical research might soon decide whether this is the case or not, and might probably indicate a solvent at once quicker and safer than the common soak; or, on the other hand, might suggest a means by which, in the original drying, this glutinous substance might be kept in a soluble condition.

Turning next to the unhairing, it is admitted on all hands that liming, even if as yet the best process known, is far from perfect. It however serves the double purpose of loosening the hair and swelling the fibre of the hide; now, the hair is fixed in its sheath by a little bulb or root of greasy matter, and to loosen it, it is necessary that this should be dissolved. The swelling of the pelt has probably little to do with loosening the hair; sweating, charcoal, and sulphide of sodium (free from caustic alkali) will loosen the hair without raising the hide; and in some cases, extreme swelling has the effect of fixing the hair after it has been loosened. Weak acids will swell the pelt without any perceptible loosening of the hair. Which, then, of the known unhairing agents loosen the hair by acting on the fatty root, and which by softening the hide in general? is a question which we may well ask of science. Probably a careful study of the action of chemicals on sections of hide under the microscope would throw light on it.

The operations of raising and bateing are both very imperfectly understood. Both acids and alkalies are well known as raising agents, and both are capable of entirely dissolving the hide fibre. Under the microscope, the fibrous structure of a thin section of hide may be well made out, especially if it be slightly coloured with a solution of magenta, and pressed between two plates of glass. These fibres in their natural state are smooth and compact; under the action of raising agents they often become ragged and imperfect, and split into numerous finer fibres. Now, it is well known that to manufacture thick, solid, and heavy sole-leather thorough plumping is required, and this is perfectly comprehensible on Knapp's theory that tanning consists merely in depositing an insoluble coating on the surface of the fibres. Naturally, the more the fibres are subdivided, the greater surface they will offer to the deposit of tanning matter. It is important, however, that this sub-division should be accomplished with as little ragging and roughening of the fibres as possible, since this must weaken the leather and render it less elastic. Do acids or alkalies do this the best? Certain salts also have a plumping action. Do they also act as solvents? Given quantities of hide might be treated with various agents, and the amount of dissolved gelatine determined in the solution by methods well known to chemists. Determination of the nitrogen present by the ordinary methods of water analysis would afford a good measure of the gelatine.

Is the object of bateing solely to remove the lime, or is it also necessary to dissolve and work out the glutinous fluid which fills the pores of the hide? If the latter be

\* British Leather Trades Association.

the case, it will explain the non-success of methods which aim simply at the former. Yet surely there are agents which will do both of these more economically than the putrefactive organisms which swarm in our pores. The action of the bate is always solvent and destructive to the hide, like that of raising agents. Why, and how, does one soften and make thinner, while the others swell and harden? Again the microscope must be appealed to, in conjunction with chemistry.

Passing on now to the tanning proper, it would be well to know whether Knapp's theory that tanning is merely a surface action can be substantiated. I, for one, have my doubts in the case of tanning proper, though probably it is perfectly true of tanning and chamoising. In these latter cases appropriate treatment will bring back the leather to the condition of raw hide, or at least dissolve the gelatine, which in the case of really tanned leather cannot be done. A piece of leather merely "struck through" will swell up in a solution of acetic acid, while the well-tanned is unaffected; now, if in this case the action was merely surface, the diffusible acid would certainly penetrate to and swell the centres of the fibres.

Again, how and in what form is the tannin deposited in sole-leather, and what is the difference between pieces of the same hide tanned for sole and for dressing purposes? It may be supposed that the more the fibre is separated by limeing, the softer a dressing leather will be, and the more stuff it will carry. This is not the writer's opinion from experience, though in the North of England shaved hides are commonly limed longer than sole-leather.

It is frequently said that the butts in their early stages are kept plump by gallic acid. Other and more powerful acids are invariably present, however, such as acetic, butyric, and lactic acids. Do these arise from souring and decomposition of the tannins, or rather from that of the sugar, starch, and gum which are always present? It is possible in many cases, if not in all, to check the fermentation of tannin by the use of suitable antiseptics, but it is not yet known whether this fermentation is due, like that of yeast, vinegar, &c., to some living organism, or rather to some peculiar ferment analogous to diastase and sinaptase. It is very possibly not only in the power of the tanner to prevent the fermentation and loss of the tannin, but to determine the fermentation of the sugar and gum, so as to yield acetic, butyric, or lactic acids, as may be found most desirable. Each of these ferments depend on a special organism, and the brewer has to examine his yeast (alcohol ferment) carefully to ascertain its freedom from the "false" ferments of acetic or lactic acid, which would sour and spoil his beer, and which even in small quantity causes most of the faults and disagreeable flavours to which beer is liable. Now, if the tanner introduces the lactic ferment instead of the alcoholic, he will similarly obtain lactic acid instead of alcohol. A solution of sugar, which with yeast will give alcohol, with the vinegar plant yields acetic acid, and with scrapings of decaying cheese or sour milk will yield lactic acid. There is no doubt that a thorough investigation of the fermentation of tannins is most necessary.

I must, however, limit my remarks, which have already claimed an undue amount of your time and patience. It is self-evident that any improvements in tannin estimation would be vitally important, that much—almost everything—remains to be known about the various tannins we employ, that methods of distinguishing and separating them are necessary and possible, and that the action of heat in their extraction needs investigation. Enough has been said to show the wide field which is open to the chemist—to quote in all seriousness the words which were applied to a still more important subject, "the harvest truly is plentiful, but the labourers are few."

It seems to the writer that if an adequate prize were offered for any valuable contribution to the science of tanning, the result would be better than if we attempted with our limited knowledge to map out a particular line of research. Even if no immediate money value was apparent,

the knowledge would be certain to pay sooner or later, either directly or by leading to further discovery.

The writer has worked, and hopes to work further, at some of the problems he has mentioned, but business leaves him so little time for any research but what bears directly on the "demands of the day," that he would gladly welcome other workers, even in the same fields, and willingly help them by whatever information or suggestion he could give.—*The Leather Trades' Circular and Review*.

## LABORATORY NOTES.

By T. A. EDISON.

HARD rubber or vulcanite, placed for several weeks in nitrobenzol, becomes soft and pliable like leather, and easily broken.

2. The vapour of chloral hydrate is a solvent of cellulose. I have found the corks of bottles containing the crystals eaten away to the depth of a quarter of an inch, the cork being resolved into a black semi-liquid. Certain kinds of tissue paper are partially dissolved in time, if thrown in a bottle containing the crystals.

3. A very difficult substance to dissolve is gum copal. I have found that aniline oil dissolves it with great facility.

4. Hyposulphite of soda is apparently soluble to a considerable extent in spirits of turpentine. Large crystals of "hypo" melt down to a liquid after several weeks, and if the bottle be shaken, partially disappear. The turpentine smell nearly disappears.

5. The vapours of iodine, in the course of several months, will penetrate deeply into lumps of bees'-wax.

6. If to a solution of bisulphide of carbon there be added twice its bulk of potassic hydraet in sticks, and the bottle be well sealed, the whole will, in two months, become an intense reddish, syrupy liquid, with scarcely any free bisulphide of carbon.

7. Some substances in solution form crystals or deposits on the sides of the bottles containing them, generally above the water line. Among such solution in 100 c.c. of rain water may be mentioned a 14-grm. solution of acetate of uranium, 8-grm. do. of proto-acetate of copper, 5-grm. do. of acetate of morphine, 10-grm. do. of formate of copper, 20-grm. do. of tannate of iron. These deposits invariably take place on that part of the bottle most *exposed to light*. This phenomena may be due to heat, but deposits or films occur in some solutions *within the liquid* as well as above it—especially noticeable with tannate of iron, the film of which adheres strongly to glass.—*American Chemist*.

## NOTICES OF BOOKS.

*Annual Record of Science and Industry for 1876.* Edited by SPENCER F. BAIRD. New York: Harper Brothers. London: Trübner and Co.

THIS annual publication continues to improve, and has certainly no rival in the English language. Its characteristic features, as compared with other works having the same general objects, are the following:—There is a general summary—or rather a series of summaries—of the progress made during the year in the various branches of science and industrial art. Upon this follow abstracts of papers, memoirs, &c., giving the details of research, invention, and discovery, the sources whence they are taken being fully given. The authorities selected are for the most part satisfactory; though one or two English journals might be considered as of doubtful value, and three French magazines might have been judiciously searched

for technological matter. We refer to the *Moniteur de la Teinture* and the *Bulletins* of the Industrial Societies of Mulhouse and of Rouen. As regards the classification of the abstracts, the editor very justly remarks that many paragraphs might be appropriately introduced under several heads, and he has therefore introduced a system of cross-references. Next follows the annual obituary of scientific men, succeeded by a list of the most important scientific works which have appeared during the year. There is an elaborate alphabetical index of authors and subjects, a systematic table of contents, and a list of the authors whose co-operation the editor has enjoyed in the compilation of the book, and especially in the preparation of the summaries of scientific progress. The majority of the physical and chemical facts mentioned will, of course, have come under the notice of our readers, which, however in no manner detracts from the value of the "Record" as a key to the scientific history of the past year, and a general note-book of discovery and invention. Mention is made of Davy's test for alcohol—a solution of molybdic acid in strong sulphuric acid. This reagent is said to produce a blue colouration if only the  $\frac{1}{1888}$  of a grain of alcohol be present.

The use of certain deliquescent salts for watering streets, in particular chloride of calcium, is mentioned as having been discussed in the French Academy. M. Houzeau is probably not aware that an English patent for this idea is in existence, and has been in actual operation in one of the metropolitan parishes.

Guyard, we are told, has "thrown considerable light on the formation of aniline-black by the discovery that the salts of vanadium have a marked influence in producing it." This passage would lead a reader not especially acquainted with the subject to think that this action of certain vanadium compounds was due to Guyard. Yet the late John Lightfoot, the original discoverer of aniline-black, distinctly mentions this influence of vanadium, as has been fully pointed out by Rosenstiehl. Pinkney, also,—we believe without being aware of what Lightfoot had done—claimed in his patent the use of vanadium for the production of aniline-black before the subject was taken up by Guyard.

Mention is made of the experiments of Böttger, Lippmann, and Neison, with the radiometer, but curiously enough there is no reference to the experiments undertaken by Mr. Crookes, and described in papers read by him at various times from March 30 to November 16, 1876, and which must certainly be regarded as no unimportant steps towards a correct theory of the phenomena in question.

Still, notwithstanding such oversights, difficult to avoid in a work of this nature, we can strongly recommend the "Annual Record" as the best book of its kind with which we have become acquainted.

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*A Handbook for Young Brewers.* By HERBERT EDWARDS WRIGHT, B.A. London: Crosby Lockwood and Co.

THE object of this little work is to present, in brief outline, the scientific principles upon which the art of brewing is based. The author treats in succession of barley, malting, and malt; of water, hops, and sugar; of mashing and boiling; of fermentation in the three forms most important to the brewer, viz., the alcoholic, the lactic, and the acetic, with an exposition of the rival theories of Liebig and Pasteur; of pale ale, black beers, bottling, and export. There is also a notice of the present and still undecided controversy between Dr. Bastian and Professors Tyndall and Pasteur on spontaneous generation. On most of the subjects touched upon the author evidently speaks as a man of practical experience. Speaking on the subject of water, he divides its possible impurities into hurtful and useful, including, under the former head, organic matter, nitrates, nitrites, ammonia, and iron; whilst the sulphates, carbonates, and chlorides

of calcium, magnesium, potassium, and sodium are, for the brewer's purpose, to be regarded as useful. Nitrates he pronounces to be the principal food of bacteria. Now, as it is asserted that much of the organic nitrogen present in sewage reappears in the effluent of irrigation farms in the form of nitrates, if this view is correct, such water must be a formidable source of contamination to the streams into which they fall. As a test for organic matter, the permanganate of potassa is recommended, but without the necessary caution that ferrous salts will produce the same reaction. "A pound of dry gypsum," says the author, "may be reckoned as seven thousand grains." We should think that this must be approximately true of a pound of any substance. In the last chapter, on "Hiring and Letting Public-houses," the author leaves the regions of science, and reveals trade practices with which the public at large can have little sympathy. It must, however, be admitted that in this system of securing customers the brewers are no longer singular. We think we could point out drysalers who contrive to get dyers into their power, though, of course, in a manner modified to suit the different circumstances of the case; and we know also of paper-makers who have letter-press printers bound by agreement to use their paper at certain prices and no other. With the political, economical, and social phases of this system we have here nothing to do, but we feel bound to denounce it on behalf of the industrial arts. The man who has secured a set of compulsory customers will care little about introducing improvements in his manufactures, and will thus contribute quite as much as any trades-union to drive important branches of industry abroad.

Upon the whole, the little work before us is a judicious attempt to bridge over the gap between theory and practice in a very important branch of chemical technology, and, as such, it has our best wishes.

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*Inorganic Chemistry, adapted for Students in the Elementary Classes of the Science and Art Department.* By DR. W. B. KEMSHEAD, F.R.A.S., F.G.S. (Enlarged Edition). London and Glasgow: W. Collins, Sons, and Company.

THE book before us is one of those elementary treatises on chemistry which have become, of late years, so numerous, and whose existence certainly proves that this science is attracting the attention of an increased number of persons, either from an honourable desire to "know," or from a more questionable ambition to "pass." The latter point of view is made here, to say the least, quite sufficiently prominent. We are told, in the outset, that the work is "written with an especial purpose, viz., for the use of pupils preparing for the first stage or elementary examination of the Science and Art Department, South Kensington;" and that, as such, "it necessarily confines itself to the subjects prescribed in the syllabus of that examination." Whilst declaring that he makes "no apology for introducing the graphic formulæ," the author adds that "the examination for which this book is specially prepared demands a knowledge of the theory of atomicity, and of its graphic representation, &c." Dr. Kemshead concludes his preface as follows:—"The work, while in the form of notes, has done good service in preparing my own pupils for the South Kensington examination; I trust that it may be equally successful in the hands of those teachers who may adopt it." We think we have known professors whose standard of "success" or of "good service" was somewhat different.

The body of the work is devoted to the consideration of the general laws of chemical combination to nomenclature, classification, and atomicity, followed by a description of seven of the non-metallic elements and their respective combinations. The facts are, of course, the same as the reader may find in other manuals, and the

point of view from which they are regarded will be at once foreseen by any chemist who reads the preface. It must not be imagined that we pronounce this book useless. So long as the present system of regarding science in general, and chemistry in particular, as something to be examined in shall endure, so long works like that before us will have no unimportant part to play. They answer their purpose, but that purpose is, in our opinion, not the highest.

## CORRESPONDENCE.

### PHOTOGRAPHING SPARK SPECTRA.

*To the Editor of the Chemical News.*

SIR,—It may interest some of your readers to know that the spark spectrum from a 6-inch spark induction-coil may be very easily photographed, and that by moistening platinum points with HCl solutions of the metals very beautiful spectra may be obtained. In this way I have obtained spectrum photographs of Bessemer steel and iron. I have the whole apparatus so arranged as to render it easy to photograph the spectra of HCl solutions of steel, pig-iron, and iron ore very quickly, the whole process first to last not exceeding thirty minutes.

It required six Grove's cells to work the coil, but finding this battery required constant changing and refitting, thus involving loss of time and trouble, I fitted up 50 Bunsen cells, using a mixture of undiluted sulphuric and nitric acid ( $\frac{2}{3}\text{SO}_3\frac{1}{3}\text{HNO}_3$ ) for the inner porous cell, and water only on the outer. This battery lasts six days, at the end of which time it is only necessary to renew the acid in one-third of the inner cells; consequently the battery lasts three weeks. It is then only necessary to syphon off the acid from the porous cells and refill, which is very soon done. I have tried various forms, but have found none to equal this for regular and constant work. I have used Bunsen's improved bichromate battery, said to be very powerful and constant, but I have not found it so good as represented. I use a single prism spectroscope, and by the usual combination of lenses photograph an enlarged image of the spectrum.

The light from the spark alone being very feeble, it requires prolonged exposure to bring out the image; indeed, I have repeatedly failed to get a good photograph of the spectrum. I found it was necessary to burn small lengths of magnesium wire just behind the spark. The additional light therefrom appears to shorten the time of exposure, fifteen minutes being ample. I use about 30 inches magnesium in twelve lengths during the fifteen minutes' exposure.

I have lately discontinued the use of wet plates, and use only the uranium dry plates; these, of course, are available for any length of time. It is common to leave the plate in the camera for hours, taking several spectra on one plate, and developing all together.—I am, &c.,

J. PARRY.

Laboratory, Ebbw Vale Iron Works.

### CONVERSION OF THE NORMAL PARAFFINS INTO THE BENZOLE SERIES.

*To the Editor of the Chemical News.*

SIR,—May I have a space as of old in your hospitable pages for a discovery which I think is of considerable interest both to scientific and industrial chemistry—conversion of the normal paraffins into the benzol series.

Here, in the United States, there are several methods of making illuminating gas from petroleum by passing it into heated retorts. I was informed by Mr. John Lerltus, of East Boston, that the tar from these gas-works resembled very much the tar from coal-gas. I examined a specimen of this tar and found that it did contain the benzol compounds, but not either phenol or cresol.

This points very distinctly to the decomposition of the normal paraffins of petroleum into the benzol compounds on a rather large scale. It seems to me that it might lead to the obtention of benzole by passing petroleum benzine (which sells here at about 7 to 8 cents per gal.) through tubes heated to the proper temperature. In connection with the manufacture of gas the yield, even if quite small, might be made to pay. At all events the new methods of gas-making will still afford us a source for benzole and its derivatives.—I am, &c.,

S. CABOT, Jun.

Boston, August 29, 1877.

## COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

AUGUST, 1877.

The following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia.		Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale	
		Saline.	Organic.								Before Boiling.	After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
<i>Thames Water Companies.</i>												
Grand Junction .. ..	Clear	0.000	0.007	0.099	0.024	18.40	7.560	0.360	0.94	1.130	12.1	3.00
West Middlesex .. ..	Clear	0.001	0.007	0.090	0.048	16.00	6.440	0.250	0.94	1.200	12.6	3.00
Southwark and Vauxhall	Slightly turbid	0.000	0.007	0.105	0.052	16.70	6.830	0.280	0.94	1.060	12.1	2.40
Chelsea .. ..	Slightly turbid	0.000	0.009	0.133	0.021	18.60	7.890	0.320	0.94	1.330	13.2	3.00
Lambeth .. ..	Clear	0.000	0.008	0.135	0.077	17.70	7.560	0.320	0.94	1.260	13.2	3.30
<i>Other Companies.</i>												
Kent .. ..	Clear	0.000	0.002	0.375	0.003	28.00	10.860	0.930	1.44	3.200	19.4	5.60
New River .. ..	Clear	0.000	0.009	0.129	0.024	17.90	7.720	0.390	0.94	0.860	12.6	3.00
East London .. ..	Clear	0.000	0.006	0.105	0.063	17.90	7.220	0.320	1.01	1.330	12.1	3.75

The quantities of the several constituents are stated in grains, and calculated in 70,000 grains of water or 1 imp. gall.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY.

# CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 9, Aug. 27, 1877.

Relation which should exist between the Diameter of the Iron Nuclei of Electro-Magnets and the Thickness of their Magnetic Coils.—M. Th. du Moncel.—For a given resistance in the circuit and with a sufficient electric intensity, the electro-magnet the thickness of whose helix is equal to the diameter of the iron has the advantage.

Observations Relative to a Recent Note by M. du Moncel on the Best Conditions for the Use of Galvanometers.—J. Reynaud.—Not adapted for abstraction.

No. 10, September 3, 1877.

Compounds of Hydrochlorate of Ammonia with the Chlorides of Potassium and Sodium.—E. Chevreul.—The author has found in guano cubic crystals formed of the chloride of sodium and the hydrochlorate of ammonia. His experiments leave no doubt as to the affinity existing between these two salts.

Considerations on the Interpretation which ought to be given to the Conditions of Maxima Relative to the Calculations of Electro-Magnetic Forces.—M. Th. du Moncel.—A reply to the observations of M. Reynaud in *Comptes Rendus*, Aug. 27.

Researches on the Phosphoric Acid of Arable Soils.—B. Corenwinder and G. Contamine.—Having found that in a field planted with beet-root 600 to 700 kilos. of superphosphate per hectare increase notably both the yield and the percentage of sugar in the roots, an investigation was commenced on the quantity of phosphoric acid present in the arable soils of the north of France. In the canton of Houdain (Pas de Calais) M. Woussen found in the soil dried at 100° an average of 1.146 gm. per kilo. The authors at Lille found, under the same circumstances, 1.265 gm. Admitting that on the average the soil of a field contains 1-1000 of phosphoric acid, we may calculate that in a hectare of surface and 35 centimetres in depth there will be found 4900 kilos. of phosphoric acid.

Certain Derivatives of Ethyl-vinyl.—M. Milan Nevoté.—The facts presented in this memoir confirm the supposition entertained some time back that the structure of butylen (ethyl-vinyl) derived from the action of zinc-ethyl upon bromide of vinyl is  $\text{CH}_3 - \text{CH}_2 - \text{CH} = \text{CH}_2$ .

*Justus Liebig's Annalen der Chemie,*  
Band 188, Heft 1 and 2.

Researches from the Laboratory of Professor Fittig.—These consist of a paper on Isomeric Sulpho- and Oxy-naphthoic Acids, by Martin Stumpf; a Memoir on Chloro-bromanilin, by R. Fittig and E. Büchner; a paper on the Behaviour of Para-brom-anilin at Elevated Temperatures; a Treatise by Ernst Ihlée on Pyromeconic Acid, and a series of investigations on the non-saturated acids. This last paper is divided into the following sections:—On the Crotonic Acid formed from Citraconic Acid and Mesaconic Acid, by A. C. Prehn; on Methacrylic Acid, by P. Ludwig; on Xeronic Acid, a New Derivative of Citric Acid, by R. Fittig; on the Addition-Products of Ita- Citra- and Mesa-conic Acid, by R. Fittig and A. Landolt; on the Behaviour of Fumaric and Maleic Acid with Fuming Hydrobromic Acid, by L. Dorn; and on the Constitution of the Non-saturated Bibasic Acids, R. Fittig.

Behaviour of Acid Chlor-anhydrides with Zinco-Organic Compounds.—D. Pawlow.—A very lengthy paper, unfit for useful abstraction.

Communications from the Chemical Laboratory of Greifswald.—These consist of a paper by Dr. U. Sachse on Dinitro-sulpho-benzolic Acid, and one by G. Heinzelmann on Certain Derivatives of Meta-disulpho-benzolic Acid.

Chemical Compounds in Liquid Storax.—Dr. W. v. Miller.—The author doubts the formation of metastyrol in storax. Cinnamic acid was found in quantity. Vanillin is not present, but there seems to be a certain amount of ethyl-vanillin. Cinnamic acid phenyl-propyl-ester was found in rather considerable quantity, cinnamic acid ethyl-ester in smaller amount. Two alcoholic bodies,  $\alpha$ - and  $\beta$ -storesin, exist in a not insignificant amount, as also the cinnamic esters of these alcohols. The sodium compound of storesin is met with in very small quantity, and also a resinous body accompanying the ethyl-vanillin (?).

Communications from the Laboratory of the University of Würzburg.—These consist of a paper by Dr. M. Conrad on  $\alpha$ -et-succinic-ester and its Derivatives; a memoir by H. Rohrbeck on  $\alpha$ -methyl- $\beta$ -oxybutyric acid, and  $\alpha$ -methylcrotonic acid; and one by E. Waldschmidt on  $\alpha$ -ethyl- $\beta$ -oxybutyric acid and ethyl-crotonic acid.

Normal Paraffins.—Dr. Carl Schorlemmer.—An examination of normal hexan and normal heptan.

Heft 3, Aug. 9, 1877.

Communications from the Laboratory of the University of Würzburg.—These consist of a paper by R. Saur on Ethyl-methyl-acetic ester and on  $\alpha$ -ethyl-methyl- $\beta$ -oxybutyric acid; a memoir by Dr. Max on Metalacetic ester.

Combinations of the Elements of the Nitrogen Group with the Radicals of the Aromatic Series; Part II. On Aromatic Phosphorus Compounds.—A. Michaelis.

Substituted Phosphenylic Acids.—The compounds here examined are nitro-phosphenylic acid with a number of its salts, amido-phosphenylic acid, and nitric diazo-phosphenylic acid,  $\text{C}_6\text{H}_4\text{N}_3\text{O}_3 \cdot \text{PO}_3\text{H}_2 + 3\text{H}_2\text{O}$ .

Miargyrite and Kennigottite.—L. Sipőez.—The author finds the composition of the former mineral to be—

Sulphur .. .. .	21.80
Antimony .. .. .	40.68
Silver .. .. .	32.77
Lead .. .. .	4.01
Copper .. .. .	0.51
Iron .. .. .	0.19
	<hr/>
	99.96

This result approaches very closely to the analyses of Rose and Breithaupt performed respectively upon specimens from Braunsdorf and Przibram. The composition of Kennigottite was found to be—

Sulphur .. .. .	20.66
Antimony .. .. .	39.46
Silver .. .. .	35.28
Lead .. .. .	1.76
Copper .. .. .	0.50
Iron .. .. .	0.25
	<hr/>
	97.91

Contributions to a Knowledge of Pyruvic Acid.—Dr. C. Böttiger.—The dry distillation of tartaric acid does not lead to the production of pyruvic acid without loss. The constitution of this acid cannot be explained from the manner of its formation. The behaviour of pyruvic acid with hydrogen, sulphuretted hydrogen, and hydrocyanic acid corresponds to the properties of a keton. The action of ammonia and of anthranilic acid upon

pyruvic acid leads to bodies which give no clue to the constitution of the latter acid.

Dinitroso-orcin and Dinitro-orcin.—J. Stenhouse and C. E. Groves.—From an English source.

*Biedermann's Central-Blatt für Agrikultur Chemie,*  
Heft 5, May, 1877.

Composition and Properties of Drinking Waters, and of Waters Serving for General Domestic Use.—Dr. August Voelcker.—Taken from the *Journal of the Royal Society of England*, vol xi., part 1, No. 21.

Conduction of Heat in Soils.—Prof. F. Haberlandt.—The conduction of heat is most rapid in rocks and is approximately in proportion to their specific gravity. Soils, especially if of loose texture, containing many spaces filled with air are relatively bad conductors. A soil saturated with moisture and puddled into a dense condition conducts heat better than water. Of the four kinds of soil tried common arable earth was the best conductor, then sand, then peat-earth, and lastly compost. It is an error to suppose that soils rich in humus are necessarily warm; the influence of their dark colour extends merely to the upper layer.

Researches on the Ash of Blood.—A. Jarisch.—It is remarkable that while in man and in the horse the quantity of potash exceeds that of soda, in the ox and especially in the dog it is very much smaller.

Experiments on the Respiration of Plants.—Dr. L. Rischawi.

The Dependence of the Respiration of Plants upon Temperature.—Prof. A. Mayer.—Not suitable for abstraction.

Analyses of Certain Plants.—A. H. Church.—This paper gives the proximate composition of the leaves of lettuce, Iceland moss, water-cress, and wheat; also of the leaf-scales of the beech and the female blossoms of the elm.

Composition of the Tubers of *Dioscorea Adulis*. Prof. J. Moser.—The roots of the yam showed on analysis:—

	Moist.	Dry.
Water .. .. .	60.722	—
Ash, freed from carbon, carbonic acid, and sand..	0.895	2.278
Nitrogenous matters .. .	4.185	11.119
Extractive matter soluble in—		
Ether.. .. .	0.348	1.561
Alcoholic sulphide of carbon .. .. .	0.265	
Cane-sugar .. .. .	4.790	12.195
Levulose .. .. .	0.180	0.458
Starch .. .. .	25.185	64.121
Pectin and non-azotised extractive matter .. .	2.033	5.176
Cellulose .. .. .	1.091	2.785
Sand .. .. .	0.003	0.007

Proportion of Potash in the Wood and Sap of American and European Vines.—Dr. Curt Weigelt.—Those species which contain most potash are least affected by the attack of the phylloxera.

Influence of Rain and Light upon the Sugar-Beet.—Dr. H. L. Riem.—The action of light in the production of sugar in the beet-root is unimportant, and its place can be fully supplied by heat.

Heft, 7, July, 1877.

Amount of Carbonic Acid present in the Air during Winter.—M. P. Truchot.—The amount of carbonic acid contained in the atmosphere in winter varies inversely with the position of the barometer. When the ground is not covered with snow, the average proportion is not

greater than during summer. Snow increases the quantity of this gas in the atmosphere.

Chemical Examination of the Drinking Water at Hohenheim and Birkach.—G. Dittmann.—The author determines the organic matter present in water by means of permanganate of potassa. The sub-editor, Prof. E. von Wolff, remarks in a note that a really quantitative determination of the organic impurities in water has not yet been found practicable. Among the characteristics of a polluted water, the author includes the presences of potassa and soda otherwise than in mere traces. He recommends that towns should be supplied with mountain waters.

Investigations on the Diffusion of Carbonic Acid through Porous Partitions, being a Contribution to the Question of the Penetrability of Building Materials by Gases.—Prof. Max Märcker and Dr. E. Berthold.—Among the materials which allow the passage of air are brick, sand-stone and calcareous tufa, whilst granite, porphyry, slate, shelly lime-stone, marble, and alabaster are impenetrable. Machine-made bricks are less permeable than those moulded by hand. Strong burning increases the porosity of bricks, but as soon as fusion sets in they become impenetrable. Pine and oak wood, in their longitudinal sections are very slightly pervious. Mortar is a very porous material, and its permeability decreases but very slightly in the course of time. Cement, when recently hardened, is highly porous, but if kept under water, or exposed to rain, its porosity is destroyed. Thin paper hangings reduce the permeability of a wall by 17 per cent, but thick glazed hangings occasion a loss of 40 per cent. A double coating of oil-paint renders all building materials impermeable. The application of water destroys more or less permeability, and a considerable time must elapse before it is restored.

The Absorptive Power of Soils for Watery Vapour and its Bearing upon Vegetation.—Prof. R. Heinrich.—The author concludes that the water required by plants must be supplied to the soil in a liquid state, as rain, dew, &c. The common opinion of the utility of the absorptive power of soils for gaseous water is therefore an error. Neither the various cultivated plants, nor those known as swamp or sand plants, have any essentially different power of extracting hygroscopic moisture from the soil.

Action of Sea Water upon the Soil.—G. Reinders.—Among the injurious consequences are the increase in the amount of chlorine, which may rise to 0.25 per cent. The chlorides of calcium and magnesium have a notable effect in retaining an excess of moisture. The reduction of the sulphates in presence of organic matter is also injurious.

Examination of the Milk of Cows of Auvergne.—M. P. Truchot.—The author concludes that during summer the milk of the Salers race is poorer in butter, but richer in casein than in winter. The Ferrand race yield a little more butter and a little less cheese. As regards the Charollais breed, the main constituents of the milk fluctuate very little. The milk of Normandy cows contains much butter and little casein. The reporter expresses some doubts as to the trustworthiness of the author's analytical methods.

*Les Mondes, Revue Hebdomadaire des Sciences,*  
Aug. 11, 1877.

The *Union Medicale* concludes a fervid eulogium of M. Pasteur to this effect:—"In all branches of learning, and in all the sections of the academies, we find expositors and demonstrators such as can be met with neither in verbose and diffuse England nor in misty and pretentious Germany!"

Aug. 18, 1877.

The Mousseron Stove.—A considerable part of this issue is taken up with an account of a stove which is to utilise all the heat derived from the fuel, to require no

chimney, produce no smoke, and generate no carbonic oxide.

Aug. 25, 1877.

The experiments with the electric light on the system of Jablochkoff are proceeding very satisfactorily, and the light produced, though equal to that of 500 Carcel burners, is not oppressive to the eyes.

MM. Picon, distillers, of St. Denis, have caused their establishment to be illuminated by the electric light. The expense does not exceed 1 franc per hour, for each focus equals 250 burners. The railway station at Lyon is also definitely fitted up with the electric light on Lontin's system.

According to M. Jos. Henri, secretary of the Smithsonian Institution, the planet Mars is found to be attended by two satellites.

Dr. Sachs, of Berlin, has spent ten months in Venezuela for the purpose of studying the properties of the electric eel, and is said to have ascertained a number of interesting facts.

Wine is often injured if put into bottles made of a glass containing an excess of lime or of alkali. The best glass for wine bottles consists of—

Silica	..	..	..	..	..	58.4
Potassa (or soda)	..	..	..	..	..	11.7
Lime	..	..	..	..	..	18.6
Alumina and iron	..	..	..	..	..	11.0
Undetermined	..	..	..	..	..	0.3
						100.0

Inferior bottle glass sometimes contains 18 to 20 per cent of lime.

Aug 30, 1877.

This issue contains no original chemical matter.

Sept. 6, 1877.

The Helvetic Society of Natural Sciences held its sixtieth annual meeting at Bex (Vaud) on the 20th of August.

*Moniteur Scientifique, Quesneville.*  
July, 1877.

The chemical matter in this issue consists almost exclusively of papers which have been already noticed, or of translations of English memoirs.

**Researches on the Aromatic Amines.**—MM. Noeltling and J. Boas Boassen.—This paper consists in an examination of monomethyl-aniline, which the authors find is often present in small quantity in the commercial dimethyl-anilines and in a sample of diethyl-aniline. To detect it they dissolve the sample in question in an excess of hydrochloric acid, moderately concentrated; add a few drops of a solution of nitrite of soda, and agitate with ether. The ether is then dried with chloride of calcium and evaporated in a watch-glass. Methyl-phenyl-nitrosamine remains as a yellow oil, and may be readily recognised by its characteristic odour. With phenol and sulphuric acid even a small quantity gives Liebermann's reaction very distinctly. Pure dimethyl-aniline gives not a trace of oil.

**Rapid Determination of Potassa and Soda.**—M. Ferdinand Jean.—The saline mixture in which it is desired to determine the potassa and soda is ground up with an excess of sulphate of ammonia, moistened with a few drops of water, heated to redness in a platinum crucible till the ammoniacal salts have completely disappeared, and treated once more with sulphate of ammonia in the same manner, so as to ensure the expulsion of all acids capable of displacement by sulphuric acid. The substance is then dissolved in boiling water, a slight excess of baryta-water is added, and the sulphates and insoluble matters are removed by filtration. The filtrate is then treated with a little seltz-water, and kept at a boil

till all excess of carbonic acid has been expelled and all the carbonate of baryta rendered insoluble. The solution is then filtered, when the potassa and soda remain in the filtrate in the state of carbonates, and are exactly neutralised with a standard solution of hydrochloric acid at the boiling-point. In this neutral liquid the weight of the chlorides present is determined by bringing the solution—by evaporation or by the addition of water, as the case may be—to a volume of 50 or 100 c.c., the specific gravity of which is then determined. Or the solution may be evaporated to dryness, and the residue may be weighed. Knowing, therefore, from the quantity of hydrochloric acid used in titration, the weight of chlorine corresponding to the two alkalies and the weight of the two chlorides, it is easy to calculate the proportions of potassa and soda. If the chlorine found is multiplied by 2.1029, the weight of the chlorides subtracted from the product, and the remainder multiplied by 3.6288, we obtain the weight of sodium chloride, whilst the difference will be the potassium chloride. If it is required to determine alkalies in presence of a superphosphate, it is prudent to neutralise with baryta-water before the sulphatisation, to prevent the formation of pyrophosphates.

**Apparatus Useful in Evaporation.**—M. F. Jean.—Solutions of silica, alumina, &c., or of substances disposed to climb up the side of the capsule, may be safely evaporated in a very simple apparatus. The capsules are placed in a fire-clay muffle resting on a base of bricks. The sides and top of the muffle are encased with iron bars to receive fuel. The muffle is thus heated from the top and sides only. A suitable pipe introduced into the muffle carries off the vapours.

*Reimann's Färber Zeitung,*  
No. 29, 1877.

This issue contains nothing of general interest.

No. 30, 1877.

A considerable part of this issue is devoted to an account of the new German Patent Law.

Sensational paragraphs on poisoning cases arising from confectionery coloured with artificial ultramarine are circulating in the German literary and political papers.

Laque serin is a yellow extract introduced into commerce by Messrs. Bayer, of Leipzig, and recommended as useful both to the dyer and the printer. Nothing is said concerning its origin or its chemical composition.

Professor A. W. Hofmann reports on a new orange colouring-matter having for its basis the radicle of naphthalin, and connected probably with chrysoidin.

No. 31, 1877.

Horseradish, dyed with magenta, is served up in certain eating-houses in Berlin as an accompaniment to what the editor calls "rum steak."

Professor Wagner communicates the commencement of a paper on rosolic acid and its relation to rosanilin.

No. 32, 1877.

The editor is about opening a college for the special study of the scientific principles of dyeing and printing.

Cases of severe illness are said to have been occasioned by raspberry juice coloured with magenta. Dr. Reimann traces the evil, not to the colouring matter, but to the spurious character of the liquid sold under this name, which in many cases is quite artificial, and contains not a trace of raspberries.

No. 33, 1877.

Dr. Martius formally denies the statement of Fr. Bayer and Co. that "aurantia" is to be regarded as a dangerous colour on account of its poisonous properties.

Blue ultramarine, if heated above  $160^{\circ}$  along with water in a closed tube, is converted into green.

According to Guyard, the proportion of vanadous chloride required for the preparation of aniline-black is 1 per cent of the weight of the hydrochlorate of aniline. According to Gouillon, only 1-20,000th part of the vanadium salt is required.

*Bulletin de la Société d'Encouragement pour l'Industrie Nationale.* Aug., 1877.

Report Presented by M. Debray on Behalf of the Committee of Chemical Arts on the Tap adapted to Gas-Burners by M. Biber.—Suppose a Bunsen burner serving at intervals for numerous chemical operations. In order to economise gas and to save the apparatus which is rapidly injured if kept constantly burning with a large flame, we may extinguish the burner and rekindle it when needed. But this operation if often repeated is a loss of time and an annoyance. M. Biber has arranged a regulating tap enabling the supply of gas to be diminished without fear of the flame "striking back," and effecting at the same time a better regulation of the heat produced. The details of the arrangement cannot be explained without the accompanying illustrations.

Report Presented by MM. Cloëz and De Luynes on Behalf of the Committees of Chemical and Economical Arts on the Optical Glasses of M. C. Feil.—A laudatory notice of the flint-glass made by M. Feil. The chemical composition of the glass is not stated, but the specific gravity of this flint-glass for optical purposes is stated as 3.537 to 3.659, and for photography as from 3 to 9 (?) 540. Its crown-glass ranges from 2.465 to 2.504 in the former case, and from 2.540 to 2.90 for the latter. It is asserted that flint-glass, like photography, is "purely a French invention."

Report on the Procedures for the Regeneration of Peroxide of Manganese in the Manufacture of Chlorine, and on the claims of Mr. W. Weldon to the great Lavoisier Medal.—M. A. Lamy.—This report fully justifies the Committee of Chemical Arts in their unanimous award of the medal to Dr. Weldon, and includes an account of the theory and practice of the process. The author remarks significantly that in Belgium the absence of import duties upon English chemicals has almost entirely suppressed the manufacture of chlorine.

Report presented by M. Troost on behalf of the Committee of Chemical Arts on a Memoir on the Working of the Californian Borax Mines.—The boracic minerals are lixiviated at a boil in large wooden cisterns holding about 14,000 litres. When the liquid rises to  $28^{\circ}$  B., the clear portion is run off into crystallising tanks 3 metres long, 2 high, and 1 in width, where the solution cools slowly down to  $25^{\circ}$ , which may take from 6 to 10 days. When it gets below  $28^{\circ}$  the process is watched, so as to get rid of the mother-liquors before sulphate of soda is deposited. When the mother-liquor is run off, there is also an escape of mud mixed with octahedral crystals of borax, which are washed in the mother-liquor of the next operation, and preserved to be refined. At the bottom of the tanks is a deposit of borax, sometime 15 centimetres thick, which is broken up with pickaxes and washed.

Patent Printed Pills.—We have received from Messrs. Burgoyne, Burbidges, and Co., specimens of their Patent "Star" Coated and Printed Pills. These pills are certainly a novelty, each being distinctly printed either with its formula and dose, or with a number or some other distinguishing mark; and, in addition to bearing its name and dose, the coating—which is said to be purely vegetable and of an absolutely innocuous description—of each sort of pill is made of a distinctive colour, so that there is no difficulty in separating them, or in selecting them for administration.

## TO CORRESPONDENTS.

WE cordially thank those gentlemen who have kindly supplied us with the requisite information relative to the various Examining Bodies, Colleges, and Schools of Chemistry given in the present number.

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# THE CHEMICAL NEWS.

VOL. XXXVI. No. 931.

## ON THE ESTIMATION OF NITROUS AND NITRIC ACID.\*

By G. LUNGE, Ph.D.,

Professor of Technical Chemistry, Polytechnicum, Zurich.

SOME time ago I proposed to myself to study the action of sulphur dioxide on the solution of chamber-crystals, or, more scientifically speaking, of nitrosulfonic acid,—



in sulphuric acid, which constitutes the acid flowing from the "absorbing columns" of sulphuric acid works, and which is commonly called "nitrous vitriol." Although this action is utilised every day on a very large scale in most sulphuric acid works—viz., in all those employing the denitrating columns invented by Mr. Glover, and bearing his name—there are great varieties of opinions existing as to its nature. Some of the contradictions arising out of these controversies, which have been more particularly carried on in German periodicals, appeared to me to arise from imperfect modes of testing for nitrous, and perhaps even for nitric, acid, and it thus became the first portion of my task to thoroughly examine at least those methods of estimating the acids of nitrogen which have been proposed or used for testing "nitrous vitriol."

### I. Estimation of Nitric Acid.

One of the oldest and probably the most widely-used method of estimating nitric acid is that first proposed by Pelouze, but considerably modified afterwards by Fresenius, viz., dissolving metallic iron in hydrochloric or sulphuric acid, adding the compound containing nitric acid, or one of its salts, heating till the action of  $\text{NO}_3\text{H}$  on the ferrous salt is complete, and all NO is given off, and estimating the unoxidised portion of the ferrous salt by means of potassium bichromate or permanganate. In the latter case sulphuric acid must be employed for dissolving the iron. If the air has access to the liquids during these operations there may be some oxidation of ferrous to ferric sulphate, at the expense of atmospheric oxygen; but a more serious source of error is the regeneration of nitrogen acids from the evolved NO, which act again upon ferrous sulphate, and thus too high a proportion of nitric acid is indicated by the process. The process, as originally proposed by Pelouze, is certainly altogether faulty; but it became most accurate when Fresenius proposed to conduct the operation with a number of precautions, the most important of which is the carrying on of the whole process in an atmosphere of carbon dioxide. The process of Fresenius is, however, somewhat lengthy and complicated, and entails the use of cumbrous apparatus, and this would militate against its use in many, especially in all works, laboratories. A modification is therefore adopted by very many chemists, consisting in dispensing with the current of  $\text{CO}_2$ , but conducting the operation of dissolving the metallic iron and partly oxidising the solution by nitric acid or its salts in a flask, fitted with a Bunsen's india-rubber valve; that is to say, a cork, through which passes a short glass tube open at both ends, but closed at the outer ends by means of a small piece of india-rubber tubing, and a bit of glass rod stopping the latter again. The india-rubber tubing is provided with a sharp longitudinal incision of about 1 centimetre's length, which allows any gas or vapour to pass out, but none to enter into the tube, and thence into the flask. In

this apparatus the steam arising from the boiling liquid soon expels the air, and prevents its injurious action upon the accuracy of the process; nor can the air enter again on cooling, as the valve prevents it from doing so, so that a vacuum is formed in the flask which ought to be of strong glass to resist the atmospheric pressure. This apparatus is so very simple that even the smallest laboratory can use it; but doubts have arisen whether the results obtained by it are really trustworthy. I have therefore made with this apparatus a number of experiments (nine), in which I worked with every possible precaution against error, and in which I employed exactly known quantities of nitric acid or potassic nitrate. In order to save the time consumed by cleaning, accurately weighing, and dissolving the iron wire, I employed in this series of experiments, as well as in all those following, a solution of pure ferrous sulphate (100 grms. per litre), acidulated with 5 per cent of sulphuric acid. Of this solution a certain volume, more than sufficient for the nitric acid contained in the test liquid, was employed, and a similar volume was tested at the same time by a standard solution of potassium permanganate; one such standardising of the iron solution is sufficient for a whole day, as the free acid prevents its too rapid oxidation. The potassium permanganate solution itself was made from pure crystals and standardised once a week with piano-forte wire in the same apparatus (taking 100 wire to contain 99.6 Fe): it was found to be unchanged after a month's standing.

The time consumed by each test till the NO was completely driven off was very inconveniently long, unless a large quantity of free acid was present, say 20 parts of  $\text{SO}_4\text{H}_2$  to each 100 parts of liquid. If there is less acid present, the reaction—as shown by the colour of NO dissolved in the solution of the ferrous salt—goes on extremely slowly, or, with great dilution, not at all, until by prolonged boiling the above concentration has been reached. It is therefore convenient to add a sufficiently large quantity of pure strong sulphuric acid at once, in order to hasten the process. A pinch of sodium bicarbonate may be thrown in as well to fill the vessel with  $\text{CO}_2$ , but my results were as accurate without as with this modification.

With proper precautions, especially if the concentration and temperature of the liquids are not such as to cause an instantaneous reaction before the air has been expelled from the apparatus by aqueous vapour, the results obtained in all the nine experiments made by this process are as accurate as it can be expected by any method; and it can be recommended to chemists even in its simplified form, as described above.

I have also made a number of experiments with the process first proposed by F. Schulze, and modified by many subsequent chemists, viz., the reduction of nitrogen acids in an alkaline solution by means of iron or zinc (aluminium has also been used for this purpose). The total nitrogen is thereby supposed to be converted into ammonia, which is collected in hydrochloric acid of known strength, and estimated by re-titrating the same. Nearly the whole of my experiments were made according to the prescription given by Siewert (*Annalen der Chemie und Pharmacie*, vol. cxxv., p. 293): he employs an alcoholic solution of potash in order to prevent the violent bumping of aqueous solutions of caustic alkali and a mixture of zinc and iron, similar to Harcourt's process, published about the same time. From the latter I adopted the recurved gas-delivery tube and the inclined position of the reduction-flask, as a precaution against spurring over of any fixed alkali. I had, however, to use caustic soda in the place of caustic potash, as I could not procure the latter free from nitre, and it is just possible that the apparently good results obtained by this process may in some cases be due to the employment of impure potash. I for my own part—working with rigid accuracy, and, if anything, overdoing all the precautions prescribed for this process (for instance, allowing the mixture to stand some

\* *Proceedings of the Newcastle Chemical Society.* Advance Sheet.

time and distilling very slowly, say three to four hours)—never obtained any satisfactory results. The ammonia produced fell short, in six experiments, from 16 to 26 per cent of that calculated from the pure potassic nitrate, &c., employed. Nor could I better the case by some experiments tried with the original plan of Schulze's, and by a modification proposed by Hager. A number of chemists have come to the same conclusion, viz., that the process of estimating nitrates by reduction in an alkaline solution cannot be depended upon; and although a number of other chemists certainly have obtained accurate results by it, this may be due partly to the fact that in some special circumstances the process does work well, whilst it does not in other cases, and partly to a compensation of the loss of ammonia by the nitre consumed in the potash employed, or by carrying over of fixed alkali. A process which gives such uncertain results, in spite of scrupulously carrying out the prescriptions given for it, ought not to be resorted to so long as any other process of undoubted accuracy is available.

## II. Estimation of Nitrous Acid.

In this case the discrepancies among the results obtained by different chemists are still greater—probably because the methods have not been controlled in many cases by means of a substance of absolutely certain composition. As such I employed silver nitrite, obtained by mixing a hot solution of silver nitrate and of sodium nitrite; it was re-crystallised twice from boiling water, and dried *in vacuo* over sulphuric acid. Its purity was proved by igniting it.

0.4780 grm. yielded 0.3357 Ag.; theory 0.3352.  
0.5057 " " 0.3532 " " 0.3546.

By means of this, several test-liquids of artificial "nitrous vitriol" were made. Each time 5 grms. of pure  $\text{AgNO}_2$  were dissolved in 500 c.c. of pure concentrated sulphuric acid, of a density of 1.842 at 15° C., in such a way that the salt only came into contact with the acid at the bottom of the vessel, so that the  $\text{N}_2\text{O}_3$  evolved was immediately dissolved by the acid, and only one or two bubbles of it escaped. The sulphuric acid employed was absolutely free from nitrogen compounds, as proved by the most delicate of all reagents—diphenylamin. The liquid obtained was perfectly clear, the silver sulphate dissolving in the strong acid.

This liquid was used for testing with potassium permanganate and potassium bichromate with urea, and the silver nitrite was tried directly by reduction in an alkaline solution (Siewert's process). It should be stated from the outset that the only really accurate method for estimating  $\text{N}_2\text{O}_3$  was proved to be that by means of potassium permanganate (first proposed by Feldhaus); but this plan also is only perfectly accurate when used in the less convenient form of running the nitrous vitriol from a burette into a measured quantity of permanganate, so as to oxidise the  $\text{N}_2\text{O}_3$  momentarily before it can split up into NO and  $\text{NO}_3\text{H}$  (with the water present), since a certain quantity of NO always escapes if the opposite plan be followed—that of running the permanganate into the nitrous vitriol. Only in one way the latter plan gave approximately good results; perhaps near enough for factory work, but never quite accurate, viz., if either the nitrous vitriol was used undiluted, the bulk of the permanganate necessary for its oxidation was run upon it, the strata were allowed to mix very slowly, and ultimately permanganate added, till the pink colour remained; or, if the nitrous vitriol—say 5 or 10 c.c.—was run by means of a pipette down to the bottom of a large quantity of water—say 500 c.c.—without mixing them at first, and then permanganate was run in, so that the reaction takes place more in the lower part of the liquid. The first plan has been proposed by Mr. Crowder, the second one by Prof. Winkler (in an unpublished letter to myself). A very large number of tests were made by every one of these modifications, but there was always a certain loss of

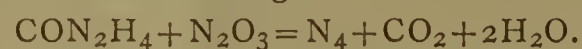
$\text{N}_2\text{O}_3$ ; and only by the process of running the nitrous vitriol into the permanganate solution, really accurate and wholly constant results were obtained. The permanganate solution was employed as a semi-normal one; that is to say, giving up 0.004 oxygen for each c.c., or indicating 0.0095  $\text{N}_2\text{O}_3$ . It had to be diluted pretty strongly—say 1.20 water—to avoid too great a heating. When the temperature of the measure rises above 80° C. the results are no more accurate; from 30° to 40° C. is the most convenient temperature, as then there is no danger whatever of any over-heating, and at the same time the reaction takes place much more rapidly than in the cold. When ordinary nitrous vitriol, of about 1.7 sp. gr., is employed, the rise of temperature caused by its mixing with the test-solution is only slight, and it is convenient to dilute the permanganate with tepid instead of cold water, in order to hasten the reaction.

Potassium bichromate has been used for years in the Tyne district for testing nitrous vitriol, and the same has been introduced into many German works by Gerstenhöfer. It is employed precisely in the same way as the permanganate, according to that plan which I have found to be the most accurate one, viz., pouring the nitrous vitriol out of a burette into a measured quantity of potassium bichromate of known strength. Its colour thereby changes soon into brownish green, and at a certain point there is a sudden change into blue-green, which shows the end of the reaction. After some practice this point can be hit with great nicety, but there is always an uncertainty to the amount of several drops, whilst with permanganate no experienced eye is required, and it is easy to work to a single drop. Since stable test-solutions can be obtained by employing pure crystallised potassium permanganate, there is no reason left for the use of the less convenient bichromate.

Bleaching-powder has also been used for the same purpose, and it seems to work tolerably well, to judge from the experiments of Mr. Davis (CHEM. NEWS, vol. xxv., p. 124), but, as the only recommendation in its favour can be cheapness, and in every other respect it is necessarily inferior to permanganate, I have not even drawn it into the range of my experiments.

I have further tried Siewert's method (reduction by zinc and iron in an alcoholic solution of potash), but, on finding no more accurate results with silver nitrite than I had previously found with potassium nitrate, I at once abandoned this tedious and troublesome plan, which has no *locus standi* besides any of the methods mentioned hitherto.

A good deal of time was, however, spent with the urea method, which has been recommended as the most accurate test for nitrous acid—first by Peter Hart (*Muspratt's Chemistry*, ii., 1040). Mr. Hart does not appear to have tested the method by pure silver nitrite (the only reliable way), but simply to have inverted Millon's urea test, and to have assumed, from theory, that the only reaction taking place is the following:—



Nitrous vitriol is dropped into a boiling solution of nitrate of urea until a drop of the liquid shows an excess of  $\text{N}_2\text{O}_3$  to be present by staining blue a mixture of starch and potassium iodide in solution. I cannot conceive that this method could ever have come into extended application. Even the costliness of pure nitrate of urea must have deterred most chemists—certainly nearly all factory chemists—from its use, otherwise its utter worthlessness would have been proved more universally before. Working with all precautions, I found that 1.230 grms. of nitrate of urea required in two experiments 18.0 and 17.5 c.c. of my artificial nitrous vitriol (prepared with silver nitrite), instead of 32.5 c.c., which it ought to have taken, and that up to the point when the starch and potassium iodide were stained blue instantaneously. But long before this point the colouration took place after a few seconds' contact, so that it is impossible to say with any degree of

accuracy when the end of the reaction had come. Nor can it be expected that Hart's method should give any accurate results, since Claus has proved (*Berichte der Deutschen Chemischen Gesellschaft*, iv., 140) that the reaction between urea and nitrous acid is anything but so simple as assumed by Mr. Hart, and that a considerable quantity of ammonium salts is formed thereby.

I also tried the plan proposed by Mr. Crowder (read before our Society in 1871, and further published in the *CHEMICAL NEWS*, vol. xxiv., p. 237), viz., to put a certain quantity of nitrate of urea in a Geissler's apparatus for estimating carbon dioxide, to run the nitrous vitriol into the delivery flask from the stoppered side tube, and to calculate the  $N_2O_3$  present from the loss of weight corresponding to the N and  $CO_2$  formed. The four following results were obtained, viz.:—

1. Employed : 26.8095 nitrous vitriol, containing 0.0359  $N_2O_3$ ; found loss of weight, 0.0463 = 0.0357  $N_2O_3$ .
2. Employed : 25.6670 nitrous vitriol = 0.03421  $N_2O_3$ ; found loss of weight, 0.0472 = 0.03587  $N_2O_3$ .
3. Employed : 25.2250 nitrous vitriol = 0.03361  $N_2O_3$ ; found loss of weight, 0.0490 = 0.0372  $N_2O_3$ .
4. Employed : 26.2163 nitrous vitriol = 0.0347  $N_2O_3$ ; found loss of weight, 0.0562 = 0.0427  $N_2O_3$ .

It will be seen that the results obtained by Mr. Crowder's process are a great deal nearer the truth than those of Hart's process, but they are still very unequal, and sometimes very inaccurate, and as the process is both costly and tedious, requiring, as it does, three accurate weighings of a heavy apparatus on a delicate balance, it cannot for a moment hold its ground beside the permanganate process, which takes a few minutes for its performance, and even in its less accurate forms, as described above, gives far better results than the urea process. Mr. Davis (*CHEM. NEWS*, vol. xxv., p. 124) has had similar unfavourable experience with both Hart's and Crowder's process. He likewise recommends the permanganate process, but without basing his judgment on the examination of a material of certain composition, such as silver nitrite.

### III. Estimation of Nitrous and Nitric Acid in the same Sample.

This can be effected in the most satisfactory way by first oxidising the nitrous acid by means of standard potassium permanganate, then adding a measured volume of a solution of ferrous sulphate of known relation to the permanganate, and finishing the process as prescribed for the estimation of nitric acid. From the total quantity of nitric acid thus found a deduction is made for that corresponding to the  $N_2O_3$ , the difference corresponding to the nitric acid originally present. It is only necessary to deduct one and a half times the number of c.c. first consumed for oxidising  $N_2O_3$  into  $N_2O_5$ , from the number afterwards found (in the shape of ferrous sulphate) consumed for reducing  $N_2O_5$  to  $N_2O_2$ ; the remainder will show how much  $N_2O_5$  (or rather  $NO_3H$ ) was present. The whole operation is carried on from beginning to end in the same flask, fitted with a Bunsen's india-rubber valve, as above described. This I proved to be altogether correct by dissolving some pure potassium nitrate in my artificial nitrous acid prepared with silver. On testing, as by the plan just described, I found—

1. Employed 0.2010  $KNO_3$ , found 0.2012.
2. „ 0.1950 „ „ 0.1936.

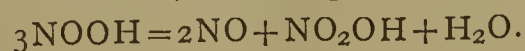
A third blank experiment was made with the nitrous acid without adding any potassium nitrate. Originally used 10.2 c.c. permanganate; found to require for reduction, ferrous sulphate equal to 15.15 c.c. permanganate instead of 15.3; the 0.15 c.c. of permanganate used in excess of the theoretical quantity in re-titrating the iron solution would be required for staining the large volume of liquid obtained at the end, so that the blank experiment may be declared to be quite satisfactory.

### IV. Analysis of Nitrous Vitriol from a Sulphuric Acid Works.

It seemed to be desirable to apply the just-described process to the analysis of nitrous acid obtained on a large scale from the absorbing column of a sulphuric acid works. I procured such from a factory on the borders of the Lake of Zürich. It had a specific gravity of 1.691, and was evidently almost saturated with  $N_2O_3$ . Eleven experiments proved it to contain 4.13 grms.  $N_2O_3$  in 100 c.c. of acid (= 2.44 per cent by weight). Now, the published analyses of nitrous vitriol generally mention the presence of  $NO_3H$  in the same as well. For instance, Winkler found 0.256 per cent, Kolb even 0.9 and 1.14 per cent, calculated as  $N_2O_5$ . It is not, on the face of it, clear how nitric acid can get into nitrous vitriol, since it cannot very well bodily traverse the chambers without being reduced to lower nitrogen oxides; and since it is not regenerated either from the latter in the presence of sulphuric acid, the oxidation in this case never going beyond  $N_2O_4$ , as proved by Winkler himself. Experiment has proved in my special case that the nitrous vitriol really contained no  $NO_3H$  whatever. The additional permanganate, over and above that corresponding to  $N_2O_3$ , amounted, in two experiments, to 0.05 and 0.1 c.c., which is just sufficient to stain the liquid; and I am inclined to believe that nitrous vitriol really does not contain any nitric acid, except perhaps traces, in any case, for I was able to show by experiment—performed purposely by the faulty method generally in use—that nitric acid was generated during the testing process where it did not exist before. My artificial nitrous acid, prepared from pure  $AgNO_2$ , and thus absolutely free from  $NO_3H$ , required, as mentioned above, for its reduction, after oxidation to  $NO_3H$  by means of permanganate, as nearly as possible exactly the theoretical quantity of ferrous sulphate, viz., that corresponding to one and a half times the quantity of permanganate first used. But this was only the case when the oxidation had taken place in the way described by me as the only accurate one, viz., by dropping the nitrous acid into the permanganate. When, purposely, the opposite way had been employed, viz., diluting the nitrous vitriol with very much water, then oxidising by permanganate and reducing again, the following results were obtained:—

1. Real percentage in 100 volumes of acid, 0.235  $N_2O_3$ , 0.000  $N_2O_5$ . Found by the above faulty method, 0.180  $N_2O_3$ , 0.045  $N_2O_5$ ; the latter corresponding to 0.027  $N_2O_3$ , leaves 0.028 for absolute loss (probably as  $NO$ ).
2. Found 0.199  $N_2O_3$ , 0.036  $N_2O_5$ , the latter corresponding to 0.021  $N_2O_3$ , leaving 0.015 for absolute loss.

It was thus positively proved that, by the more usual plan of testing nitrous vitriol, nitric acid is generated in the process of dilution, according to the equation—



### ON THE PRECIPITATION OF MANGANESE BY HYDROGEN PEROXIDE.\*

By G. ROSENTHAL, Ph.D.

It is a well-known fact that hydrogen peroxide and manganese peroxide decompose each other with liberation of O. This can easily be demonstrated by suspending recently precipitated  $MnO_2.H_2O$  in water and adding thereto a solution of  $H_2O_2$ . A brisk evolution of O sets in, and by the addition of a little acetic acid  $MnO$  is dissolved and may be separated by filtration, or if a sufficient quantity of  $H_2O_2$  were used the liquid would become quite clear. If, now, in the presence of undecomposed  $H_2O_2$  ammonia is added, the Mn goes down again as

\* Partly published in *Dingler's Polyt. Journ.*, July, 1877.

hydrated peroxide. This observation led to a series of experiments with the view of estimating manganese by using  $\text{H}_2\text{O}_2$  instead of Br or Cl. The result is that Mn can be conveniently and accurately precipitated as peroxide of ammonia after addition of a solution of  $\text{H}_2\text{O}_2$ .

As Mn is mostly associated with Fe, as in ores, slags, spiegeleisen, and ferro-manganese, I proceed to describe the mode of precipitation after the Fe has been separated from the solution of the chlorides by acetate of soda. The filtrate from the iron acetate containing free acetic acid is boiled down to about 150 c.c. and allowed to cool. A solution of  $\text{H}_2\text{O}_2$  (10 vols. commercially) is then added in the proportion of about 10 c.c. for every 0.1 or 0.15 gr. Mn in the liquid. After half an hour or an hour neutralise with a few drops of dilute ammonia, when the Mn goes down in the form of black flocculent  $\text{MnO}_2 \cdot \text{H}_2\text{O}$ , while evolution of O ensues from the action of  $\text{NH}_3$  upon  $\text{H}_2\text{O}_2$ . Heat gently, renewing the addition of ammonia carefully until the excess of  $\text{H}_2\text{O}_2$  is destroyed. It is thus easy to control the precipitation so that the smell of ammonia after its completion is just perceptible. When the Mn is totally precipitated it has the tendency to separate in flocks, the supernatant liquid remaining clear. This characterises the end of the precipitation as with hydrated oxide of iron thrown down by ammonia. The warming can be continued to unite the particles of the voluminous precipitate and facilitate its subsidence. It can be filtered at once, decanted with hot water, and finally washed on the filter until the Cl reaction disappears. With proper manipulation the precipitate should be black. A large excess of  $\text{H}_2\text{O}_2$  is to be avoided; an insufficiency renders oxidation incomplete of part of the Mn remaining in solution; the portion precipitated is brown or brownish and does not settle properly; much  $\text{NH}_4\text{Cl}$  is objectionable, but a small amount is immaterial.

Where no iron is in solution with the manganese, the latter can at once be precipitated with  $\text{H}_2\text{O}_2$  after addition of sodic acetate.

I estimated the Mn in the foregoing manner with great accuracy and rapidity. In a few cases where the necessary precautions had been omitted, a little Mn was detected in the filtrate by  $\text{NH}_4\text{S}$ , but the precipitations were absolute when I operated as described. I abstain from the quotation of the analyses made with the above-named substances and artificial mixtures of Mn with other salts, as the figures which I shall give later on will satisfy every chemist that the method is as accurate, if not more so, than any hitherto known.\* I will only allude to the generally adopted bromine method.

One great advantage of the  $\text{H}_2\text{O}_2$ , and one apparent to everyone using it, is that no solids are brought into the solution with it, and that after the precipitation of Fe it is possible to work throughout with small volumes of liquid, an advantage not to be underrated in the complete analyses of ores. But as in many cases nothing more than the estimation of Fe and Mn is wanted, a comparison will be more useful in regard to other substances going down with the manganese as impurities.

Mr. Riley† has already in his recent valuable communication to the Iron and Steel Institute made some important observations as regards the presence of ZnO and BaO in manganiferous iron ores, and I can in the main confirm his results when Br is used to precipitate the Mn. I had hoped it would be possible to keep those metals in solution when using  $\text{H}_2\text{O}_2$ . Unfortunately this was not the case in my experiments. Both BaO and ZnO went down and could be discovered and estimated by separation from the Mn. As it was not in my intention to test the merits of acetates of soda and ammonia respectively for the precipitation of the iron, I have throughout used the former as being more suitable. The following figures show a few results obtained by Br and  $\text{H}_2\text{O}_2$  respectively:—

0.6666 gr. ore gave by—

	$\text{H}_2\text{O}_2$ Gr.	Br. Gr.
$\text{Mn}_3\text{O}_4$ .. .. .	0.1440	0.1469
Containing BaO .. ..	0.0038	0.0048
Leaves $\text{Mn}_3\text{O}_4$ .. ..	0.1402	0.1421
Mn per cent .. .. .	15.15	15.35

0.7291 gr. of another cargo gave by—

	$\text{H}_2\text{O}_2$ Gr.	Br. Gr.
$\text{Mn}_3\text{O}_4$ .. .. .	0.1860	0.1868
Containing ZnO .. ..	0.0158	0.0152
Leaves $\text{Mn}_3\text{O}_4$ .. ..	0.1702	0.1716

A third cargo gave by—

	$\text{H}_2\text{O}_2$ Gr.
$\text{Mn}_3\text{O}_4$ .. .. .	0.2419
Containing ZnO .. ..	0.0214

Leaves  $\text{Mn}_3\text{O}_4$  .. .. . 0.2205

$\text{Mn}_3\text{O}_4$  found in filtrate of ZnS = 0.2190.

By both methods about the same quantities of ZnO and BaO were precipitated, but the  $\text{Mn}_3\text{O}_4$  found by Br was a little higher than that by  $\text{H}_2\text{O}_2$ . The same difference is more obvious in other cases, for instance in a sample of ferro-manganese of 45 per cent Mn. In this analysis both portions of  $\text{Mn}_3\text{O}_4$  were re-dissolved for re-precipitation, but the reagents were reversed.

Equal vol. of solution gave—

	a. By $\text{H}_2\text{O}_2$ .	b. Br.
$\text{Mn}_3\text{O}_4$ .. .. .	0.3006 gr.	0.3045 gr.

after re-dissolving—

	a. By Br.	b. $\text{H}_2\text{O}_2$ .
$\text{Mn}_3\text{O}_4$ .. .. .	0.3026 gr.	0.3030 gr.

a had gained 0.0020.

b had lost 0.0015.

The two precipitates were taken and submitted to an oxidation test with iron wire and permanganate of potash:

$\text{Mn}_3\text{O}_4$  found = 0.6020 gr.

There is a deficiency of 0.0036  $\text{Mn}_3\text{O}_4$ ; but allowing for an error in a test where each part of Fe found represents two of  $\text{Mn}_3\text{O}_4$ , or allowing for a possible difference between the real filter ash and that assumed to be present, 0.3010  $\text{Mn}_3\text{O}_4$  found is nearer the original weight 0.3006 than 0.3045.

The excess weight by Br is probably alkali; therefore to ensure perfect accuracy, a second precipitation of the Mn as carbonate would seem necessary. Not so with  $\text{H}_2\text{O}_2$ .

It is true that the presence of more ammonia salts would partly eliminate the errors caused by ZnO, BaO, &c., as Mr. Riley points out; but even then a subsequent separation of ZnO will be necessary in accurate analyses, while BaO can be separated with the silica before the precipitation of the Fe, as acetates keep small quantities of  $\text{BaSO}_4$  in solution. On the other hand, the results by  $\text{H}_2\text{O}_2$  prove that those oxides will go down with the Mn, not by reason of the alkalinity of the sodic acetate, but of the great affinity of ZnO, BaO, &c. to oxide or peroxide of manganese.

As regards CaO one experiment will suffice to show that the error caused by this base is insignificant when  $\text{H}_2\text{O}_2$  is used. A spiegeleisen slag gave—

1. Precipitation Mn = 18.23 per cent.
2. " " = 18.03 " "

The difference of 0.20 per cent was CaO;  $\text{NH}_4\text{Cl}$  was present. When working slags or ores rich in CaO with Br, serious mistakes must be made in consequence of the

\* Here I would remark that  $\text{H}_2\text{O}_2$  has been proposed by Mr. Wanklyn for the detection of Mn in waters. See "Water Analysis," third edition, p. 48.

† "On the Estimation of Manganese, &c.," by E. Riley, F.C.S.

excess of  $\text{NH}_3$  used, and of allowing the alkaline solution to stand.

In conclusion I would speak against the necessity of the second precipitation of the Fe, which has been often declared indispensable, and more recently by Riley and Shöckmann.\* The latter has quoted his results in proof of it, but the quantities of Mn in the second filtrates are so variable that they cannot possibly be taken as proving an absolute necessity. While the percentages of Mn in the analysed samples of spiegeleisen vary from 9 to 11 per cent (in one case 14 per cent) the Mn found in the second filtrate varies from 0.25 to 1.04 per cent. If the same mode of operation had always been used, the relative proportions of Mn left with Fe to the total quantity in solution ought to have been at least approximately the same, provided the same quantities of substance were operated upon. I have often examined my basic acetate of iron for Mn, and have not been able to detect more than traces in the filtrate. It is not to be seen why the results should be at variance when working every time with about equal volumes of liquid of equal concentration, and at equal temperatures, and when using about the same quantities of reagents. It depends upon the manner of the precipitation. I found the best way to neutralise with carbonate of soda until the liquid just remains turbid after heating almost to boiling, and before a precipitate is produced, to add a measured volume of a 25 per cent solution of crystallised sodic acetate previously heated to boiling, and in the proportion of about 10 parts of the salt to 1 part of Fe. After this the liquid is boiled for a few minutes, and then the precipitate settles rapidly. My friend Mr. Arnold will continue these experiments.

## REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.†

By Dr. A. W. HOFMANN.

(Continued from p. 136.)

### COMPOUNDS OF NITROGEN.

*Ammonia and Ammoniacal Salts.* By M. SEIDEL, Director of a Manufactory in Amsterdam.

Although in the report of the London Exhibition of 1862 it was justly asserted that the ammonia manufacture was still in the same condition as in 1851, there has been during the last ten years an essential alteration, and this branch of industry has been developed in an unexpected manner both technically and commercially.

Up to 1860 the manufacture of ammoniacal salts was trifling in proportion to the existing supply of the raw material. The price of the products was too low to stimulate an increased production, and the technical manipulations were generally of a very primitive character.

Latterly, and especially since 1870, the use of the sulphate of ammonia for agricultural purposes has increased year by year, and both the technical and the commercial evolution of the manufacture have kept pace with the growing demand.

Among the ammoniacal salts met with in commerce the sulphate has a quite preponderating importance, and is used almost exclusively in agriculture or in the manufacture of alum.

The use of caustic ammonia has also greatly increased, but, on the other hand, the consumption of sal-ammoniac, both sublimed and crystallised, has greatly fallen off, so that in many establishments the plant for this branch has been removed and replaced by apparatus for the production of the sulphate of ammonia.

The sources of ammonia have remained essentially the same.

The first rank is still occupied by the so-called ammoniacal liquor or gas-water from the gas-works, in comparison with which all the other raw materials may be said completely to vanish.

The quantity of ammoniacal salts obtained from the by-products of the prussiate of potash works, from the manufacture of animal charcoal, and from putrid urine, &c., form but a very small fraction of the total production.

Proposals for opening up new sources of ammonia have certainly not been wanting. Thus Hunt\* patented in England a process for obtaining sal-ammoniac by passing a mixture of hydrochloric acid and nitrogen (or air) over ignited coke, previously saturated with ferric or manganous chloride. This is merely the resuscitation of a proposal made eighteen years ago by R. Wagner,† the only difference being that Hunt uses salts of manganese, whilst Wagner recommends a salt of magnesia. The process has not hitherto obtained industrial importance. The same may be said concerning Hutchinson's‡ process, which consists in distilling the nitrogenous residues of the starch manufacture in retorts along with lime or caustic soda. Brief mention must also be made of the method of Coste and Paupin de Rosnay§ for utilising the ammonia of canal-water.|| The water is to be mixed with magnesia and a soluble phosphate, the precipitate of ammoniacophosphate of magnesia is to be collected, dried, and ignited with lime in retorts. The ammonia given off is conducted into an acid, whilst the residue is utilised as manure. In this case also the matter has not gone beyond the experimental stage.

*Preparation of Ammonia from Gas-Liquor.*—The ammoniacal liquor which collects partly in the condensers and partly in the washing apparatus of gas-works consists of a mixture of volatile and fixed salts of ammonia in very variable proportions. Among the former are ammonium sulphide and carbonate and free ammonia, whilst the latter consist mainly of the ammonium salts of sulphocyanogen and hyposulphurous acid, along with traces of the sulphate and chloride. The total percentage of ammoniacal compounds fluctuates greatly, but as it is to the advantage of the gas-works to absorb the ammonia as far as practicable, and as concentration of the gas-liquor increases its value, it is now generally delivered stronger than was formerly the case.

The approximate valuation of the ammoniacal liquor is effected by means of a hydrometer, but as the specific gravity of the liquor is essentially affected both by the quality of the water originally used and by the presence of foreign constituents, the hydrometric valuation is very uncertain, as will appear from the following table, in which samples of gas-liquor of equal value according to the hydrometer, but different in strength according to analysis, are grouped together.

Degrees Beaumé at 15° C.							
2°	2.50°	3°	3.50°	4°	4.50°	5°	6°
1.16	1.30						
1.42	1.43						
1.50	1.63	1.63					
1.77	1.77	1.76	1.87				
	1.98	1.90	2.00				
	2.18	2.10	2.24				
	2.65	2.38	2.40	2.55			
		2.45	2.72	2.72	2.79		
				2.90	2.85		
				3.40	3.06		
					3.40		
					3.53	3.67	3.74

\* Hunt, CHEM. NEWS, 1864, ix., 62.

† R. Wagner, *Wagner's Jahresberichte*, 1856, 83; 1857, 122.

‡ Hutchinson, CHEM. NEWS, 1864, ix., 31.

§ Coste et Paupin de Rosnay, *Ann. d. Génie Civil*, 1867, 807; *Monit. Scientifique*, 1868, 516; *Deutsche Industrie Zeitung*, 1868, 298.

|| The water in question is probably that of Dutch canals which receive the sewage of the streets through which they pass. The same process has been patented in England for the treatment of sewage.—Ed. C.N.

\* Fresenius, *Zeitschrift für Analyt. Chemie*, 1877, p. 172.

† "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

The percentage of fixed ammonia is on the average 0.3, whether the hydrometer indicates a higher or a lower degree. The percentage of sulphur ranges from 0.33 to 0.50.

The utilisation of the liquor is generally effected by expelling the gas by distillation in iron boilers, which are heated either by direct fire or by steam, air being simultaneously forced in [J. Braby\* and J. Baggs]. Certain English manufacturers make use of apparatus resembling the scrubbers at gas-works in which the gas-liquor flows down from above, whilst the steam at a high tension rises up from below—a process objectionable in so far that such establishments can either not use lime at all, or must employ it under unfavourable conditions.†

In the establishment of Messrs. Van der Elst and Matthes, of Amsterdam, the ammoniacal liquors from most of the Dutch gas-works are treated for sulphate of ammonia as follows, having been brought by water in barges specially constructed:—

The liquor is distilled in iron stills, holding from 35 to 50 hectolitres each, and heated by steam, which is furnished by five steam-boilers of 30 horse-power each. The stills are fixed at the same level, and are grouped in pairs, which can be worked alternately, being connected by reciprocating cocks.

The volatile constituents are first distilled off without the addition of lime, and then the quantity of milk of lime required for the decomposition of the fixed ammoniacal salts is driven in by steam-pressure. The products of distillation pass first into a collecting vessel, and from here through 5-inch (13-centimetre) valve-cocks into large receivers filled with sulphuric acid, in which the ammonia is absorbed without the slightest loss, since the cocks are so arranged that the products may be conducted at will into one or the other receiver.

The residual watery vapour, plentifully contaminated with sulphuretted hydrogen and carbonic acid, is removed from the receivers by a special chimney fitted with an arrangement for burning the sulphuretted hydrogen.

The escaping vapour, on its way to the chimney, traverses prolonged series of pipes, which raise the temperature of the gas-liquor about to be distilled to 50° or 60°. Besides an important economy in fuel, this arrangement produces the further advantage that the gaseous mixture deposits a great part of its watery vapour, which greatly facilitates the combustion of the sulphuretted hydrogen.

The annual production at the works of Van der Elst and Matthes amounts to about 1200 tons sulphate of ammonia.

All establishments where gas-liquor is treated in quantity are compelled to pay great attention to the pernicious emanations which are inseparably connected with this manufacture.

Unless proper precautions are taken, not alone the residents in the neighbourhood suffer from the copious development of sulphuretted hydrogen, but the men employed in the works are attacked with violent inflammation of the eyes.

\* J. Braby, CHEM. NEWS, xx., 182.

† The following description of the apparatus used in the manufacture of caustic ammonia at the works of Messrs. Jaffé and Darmstädter, of Berlin, has been communicated to the editor by Dr. L. Darmstädter. It consists of three superposed boilers containing about 50 hectolitres, the two lower being heated by direct fire, and provided with agitators to ensure a perfect commixture of the lime and the gas-liquor and to prevent the lime from burning to the bottom of the boiler. The upper boiler serves as a preparatory heater, and to a certain extent as a dephlegmator. The gas from the third boiler is passed for the removal of watery vapour through an arrangement of Liebig's condensers as extended as possible and preferably 20 to 25 metres in length, from which it finally escapes into the washing bottles and condensing apparatus, which are connected together by means of a tube filled with wood-charcoal for the absorption of any residual empyreumatic matter. By a sufficient length of the pipes and by the interposition of more washing-bottles it is possible to obtain chemically pure ammonia. In the manufacture of caustic ammonia it is of course essential to introduce into the still before the commencement of the operation the whole of the lime needful for decomposition, as otherwise the resulting product may be easily contaminated by volatile ammoniacal compounds, such as ammonium sulphide and carbonate.

The progress made in this direction consists principally in the improvement of the burners for the combustion of the noxious gas and the construction of chimneys with increased draft.

The Compagnie Parisienne d'éclairage et de chauffage par le gaz, which in its three large establishments produces yearly about 3000 tons sulphate of ammonia, and, in addition, large quantities of caustic ammonia, has described, in a special treatise,\* the arrangements adopted for the sanitary improvement of its works.

As another important improvement must be mentioned the safety-valves which are now attached to every still. Although, under ordinary circumstances, these apparatus work at a very low pressure, obstructions may nevertheless be produced in the gas delivery-tubes under a variety of circumstances, and may easily occasion explosions, such as took place in 1867 at the establishments of Van der Elst and Matthes, of Amsterdam, and of Kunheim and Co., of Berlin. These dangers are, once for all, obviated by the introduction of safety-valves.

(To be continued.)

## SEPARATION OF NICKEL AND COBALT.

By Dr. T. L. PHIPSON.

THE separation of nickel and cobalt has hitherto been a somewhat difficult operation, but by the new method, which I made known a short time ago, this is effected easily and rapidly. The following method of detecting and isolating minute quantities of nickel in commercial chloride of cobalt, supposed to be pure, will give an idea of its practical nature:—A few grains of that salt are dissolved in water, and the whole of the cobalt precipitated, with the nickel, by xanthate of potash employed in slight excess, and previously dissolved in a little distilled water. A few drops of ammonia are then added, just sufficient to render the liquid slightly alkaline, and the dark green xanthate of cobalt is collected on a filter. The whole of the nickel is in the filtrate, and the whole of the cobalt in the filter. The nickel in the filtrate is precipitated by a few drops of sulphide of ammonium.†

*Character of Xanthates.*—Besides the yellow precipitate which the soluble xanthates give with salts of copper, all the insoluble xanthates, on dissolving in nitric acid, give rise to nitrous ether, which is readily recognised by its odour.

## OBITUARY.

RICHARD APJOHN, M.A.

WE have, with regret, to record the death, in the thirtieth year of his age, of Richard Apjohn, M.A. Mr. Apjohn was a young chemist of great promise. In 1870 he matriculated as First Gold Medallist in Trinity College, Dublin. In 1871 he visited Germany, and studied in the laboratories of Professors Kekulé and Clausius, of Bonn. In 1872 he was elected Prælector of Chemistry in Caius College, Cambridge. In 1876 the University of Cambridge conferred on him the degree of Master of Arts. He was also a Fellow of the Chemical Societies of London and Berlin, and public analyst for Cambridge, Cambridgeshire, Huntingdonshire, and the Isle of Ely. He died at the Midland Hotel, London, after a short illness, on September 12, 1877. Amongst his contributions to science were the following:—

\* Note relative aux divers produits et aux ouvrages exposés à Vienne par la Compagnie Parisienne.

† The precipitate of sulphide of nickel dissolved in nitric acid yields no trace of cobalt, showing that the separation is perfectly complete.

1. "A Refutation of an Attack by the Rev. Mr. Highton, on the Experiments and Conclusions of Joule, respecting the Mechanical Powers of Electro-magnetism, Steam, and Horses." (*Chemical News*, March 3, 1871).

2. "On the Occurrence of Vanadium and Titanium in the Trap Rocks of Different Countries." (*Chemical News*, October 18, 1872).

3. "On the Analysis of a Meteoric Stone and the Detection of Vanadium in it." (*Journal of the Chemical Society*, February, 1874).

4. Description of a Simple Method of Estimating Urea with Speed and Precision." (*Chemical News*, January 22, 1875).

#### ALPHONS OPPENHEIM.

ON Monday the 18th inst., there died, at St. Leonard's, Alphons Oppenheim, whose chemical researches have so frequently been alluded to in our "Chemical Notices from Foreign Sources." Dr. Oppenheim had only recently been appointed Professor of Chemistry at Munster, Westphalia. He has occasionally visited St. Leonard's during the past few years for the benefit of his wife's health. His wife's illness was to him the cause of deep grief and anxiety, which increased when it became known to him that there was no hope of her recovery. She died at an early hour on Sunday, the 17th inst., and his grief became so great that in two hours afterwards he put an end to his own existence. A post-mortem examination showed that death had been caused by prussic acid. At the inquest the jury, without hesitation, returned a verdict of "Suicide while in a fit of temporary insanity."

#### NOTICES OF BOOKS.

*Condemned Meat: a Report to the Sanitary Committee of the Honourable the Commissioners of Sewers of the City of London upon Various Methods of Dealing with Meat seized as unfit for Human Food in the City of London.* By W. S. SAUNDERS, M.D., F.S.A., Medical Officer of Health and Public Analyst for the City of London. London: Skipper and East.

To prevent the meat seized from occasioning a nuisance during its transit, the author immerses it in a solution of "Cooper's salts," copperas, and picric acid. The first-mentioned of these ingredients is a patented mixture of the chlorides of sodium, calcium, and we believe of magnesium, obtained from the waste of certain manufacturing operations, and has been used with success, in the form of an aqueous solution, for watering streets. The copperas and picric acid are added, not so much as disinfectants as to prevent the meat from being surreptitiously sold for human food. The amount of meat which requires thus to be dealt with is occasionally very great, as much as 35 tons having been seized and condemned in a single day.

For the transport of the putrid meat Dr. Saunders proposes the use of water-tight carts, made of oak with cemented joints—in fact, cisterns on wheels.

Among the various methods for the ultimate disposal of this large quantity of offensive matter the author mentions—but, to do him justice, without approval—the strange suggestion to convey down the river in barges fitted with water-tight compartments, and deposit it in the sea "beyond the reach of tidal influences." Of course such a waste of phosphoric acid and nitrogen would be grievous to chemists who know the importance of these substances in the economy of the vegetable world. But that school of sanitarians who advocate the conveyance of sewage into the sea, or into tidal rivers, may possibly contend that condemned meat should be treated in like manner. Indeed the waste of condemned carcasses

would not involve the use of such costly machinery as does the squandering of the fertilising matters contained in sewage. The total weight of meat condemned in the City during the year 1876 was 238 tons 2 cwts. 2 qrs., whilst the fish seized at Billingsgate for the same year amounted to 358 tons 15 cwts., making a grand total of nearly 600 tons of animal matter, which, if judiciously treated, ought to do more than merely cover the expenses contingent on its removal. How much putrid fish, &c., is thrown upon the waste grounds in the districts governed by the "vestries" it would be impossible to calculate, but many a time and oft our "unguarded nose" is suddenly saluted by whiffs which convince us that there is "something rotten" very much nearer than "in the State of Denmark."

We congratulate the City authorities on the ability and energy which Dr. Saunders evinces in his difficult and unpleasant duties, and we wish that the same zeal were manifested in other quarters.

*The Manchester and Thirlmere Scheme: An appeal to the Public on the Facts of the Case.* Manchester: J. Heywood. Windermere: J. Garnett. London: Simpkin, Marshall, and Co.

WE had heard, of course, of the existence of a "Manchester and Thirlmere" scheme, but, like the majority of the nation, we supposed nothing more was intended than merely to tap the lake and utilise a portion of its surplus waters for the supply of Manchester, just as was done in the case of Glasgow and Loch Katrine. Had we been aware that it was in contemplation to turn an army of contractors and "navvies" into the beautiful Vale of Wythburn, to raise the level of the lake some 35 to 40 feet by means of a formal embankment, laying its picturesque shores under water, and substituting for the old winding road "a straight road cut on a level line," we should have deemed it our duty to have already entered our protest. We agree with the author of this pamphlet that before any such scheme is sanctioned it should be proved, first, that the increased water-supply is really needed, and secondly, that such supply cannot be obtained without an outrage upon good taste. If it is now too late to preserve the Lake District in the manner of which the American Government has recently set a brilliant example, all further engineering and manufacturing operations within its limits should be absolutely prohibited.

#### CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 11, Sept. 10, 1877.

**Methods for Preserving the Flesh of Fishes.**—M. R. M. d'Amélio.—The fish, cut in slices for the sake of obtaining a more rapid result, is steeped in water acidified with citric acid and dried. To soften it it merely requires to be left for three or four days in water. If kept for a long time it becomes as hard as wood, and the fatty parts have an odour of tallow. As a "better process" he steeps in a mixture of silicate of potassa and glycerine, washes, and dries.

**Specific Heat and Melting-Point of Platinum.**—M. J. Violle.—The mean specific heat between 0° and 1177° is 0.0388. The melting-point is probably a little below 1779°.

**Note on Specific Inductive Power.**—M. V. Meyreneuf.—The author has endeavoured to find what modifica-

tion in the energy of the spark is produced by a change in the nature of the insulating plate of a condenser.

**On Nitroso-guanidin.**—M. Jouselin.—This compound is formed from guanidin by replacing H by NO, a result obtained by dissolving the nitrate of guanidin in fuming nitric acid, and passing through the solution a current of nitrous acid, and pouring the mixture, after twenty-four hours, into excess of cold water, when there is produced an abundant precipitate of felted crystals resembling amianthus. The new compound is represented by the formula  $\text{CH}_4\text{N}_4\text{O}$ .

Moniteur Scientifique Quesneville.  
August, 1877.

**Phylloxera, and the means proper for Neutralising its Action on the Vine.**—M. Charles Blondeau.—A long account of the various methods adopted for the destruction of this enemy of the vineyards.

**New Applications of the Sulphide of Carbon.**—F. Rohart.—A method for disengaging the bisulphide of carbon in the state of vapour. The author maintains that several millions of vines have been freed from the Phylloxera by his process.

**Discussion between MM. Wurtz, Sainte-Claire Deville, and Berthelot.**—A continuation of the well-known discussion before the Academy of Sciences.

**Contribution to the Knowledge of Veratrin.**—MM. Ernst Schmidt and R. Kœppen.—Taken from *Liebig's Annalen* for Feb. 17, 1877.

**Studies on Salicylic Acid and the Salicylates; Treatment of Acute and Chronic Rheumatism, of Gout, and various Affections of the Sensitive Nervous System with the Salicylates.**—Prof. Germ. Sée.—A medical paper.

**Chrysolin, a new Yellow Dye derived from Resorcin.**—F. Reverdin.—Already inserted.

**Correction of the Errors due to the Variations of Temperature in Reading Hydrometers.**—P. Casamajor.—A tabulated set of corrections for Balling's hydrometer, arranged for weak saccharine solutions.

**A new Burette.**—P. Casamajor.—A modification of the Binks burette, the exact structure of which cannot be made intelligible without the accompanying diagrams.

The American Journal of Science and Arts.  
No. 77, May, 1877.

**On Vortex Rings in Liquids.**—J. Trowbridge.—The author finds that the formation of liquid rings is a necessary result of the fundamental equations of strains and those of hydrodynamics; and that they constitute not a special but a general phenomenon. A drop of water falling into water from a suitable height must assume the ring shape. Vortices can and do arise in certain processes of diffusion.

**An Account of Discoveries of the Rev. Augustus Wing in the Geology of Vermont.**—J. D. Dana.—The first part of a report describing the main geological features of the region studied by the late Mr. Wing. This indefatigable observer in his hours of leisure is declared to have done more towards elucidating the age of the Vermont rocks than had been effected by the State Geological Survey.

**Note on the History of Helianthus Tuberosus, the so-called Jerusalem Artichoke.**—J. H. Trumbull and Asa Gray.—That this plant has no connection with Jerusalem every botanist is of course aware. Its origin has been disputed, some assigning it to Brazil, others to Peru and Mexico, and others, again, to Canada. It appears to be a native of the United States from New England to Kentucky, and to be identical with *H. doronicoides*.

**Examination of American Minerals.—No. 6. Columbic Acid Minerals.**—G. Lawrence Smith.—The author maintains that the metal known in England and on the Continent as niobium should be called columbium, the name by which it is designated in America. The confusion is said to have originated as follows:—"Ekeberg discovered, in 1802, a supposed new metal, which he called tantalum, but which a short time afterwards was regarded as identical with columbium; and for forty-five years tantalum and columbium were synonymous terms in all works on chemistry, although Wollaston suspected their dissimilarity. Secondly, when H. Rose made his well-known exhaustive researches on the columbite of Bodenmais, he showed that this mineral contained, not one, but two metallic acids. One of these was *tantalum*, and the other he supposed to be a new metal, which he named *niobium*. Subsequent examination, however, convinced Rose that the two metallic acids obtained from the Bodenmais columbite were really the original columbic acid of Hatchett, discovered in 1801, and the tantalic acid discovered by Ekeberg in 1802." The former body, therefore, should have retained its original name. The remainder of the paper is devoted to the examination of the columbic minerals, columbite, microlite, pyrochlore, hatchettalite, samarskite, yttrotantalite, euxenite, Fergussonite, and Rogersite.

**Sensitiveness to Light of various Salts of Silver.**—Carey Lea.—An examination of the power of various salts of silver to produce latent images, capable of development by the action of pyrogallol and ammonia.

Beiblatter zu den Annalen der Physik und Chemie,  
No. 1, 1877, Band 1, No. 2.

**Magnetism of Soft Iron Cylinders and of several Hard kinds of Steel.**—Dr. Christoph Ruths.—Not adapted for abstraction.

**Recent Experiments with the Radiometer, and their Explanation.**—An abstract of some of the more recent papers of Mr. Crookes, as also of the researches of MM. Alvergnyat, Govi, Ducretet, Gaiffe, Salet, de Fonvielle, Jeannel, Schuster, &c.

**The Spectrum of Indium.**—W. Claydon and Ch. T. Heywon.—Taken from the *Phil. Mag.*, ii., p. 387.

**The Theory of the Reflection and Refraction of Light.**—A. Lorentz. (Inaugural Dissertation). Arnheim: Van der Sande.—The author considers that Maxwell's theory of light essentially explains the phenomena, in so far as they have been examined.

**Photometric Measurements in the Different Parts of the Spectrum.**—R. Trannin.—The author has invented a new method for comparing the intensities of different rays of light of the same length of undulation. The rays emanating from two sources of light, A and B, are thrown upon the slit of the collimator of a spectrum apparatus by two small totally-reflecting prisms in such a manner that the rays from A illuminate the upper part, and those from B the lower part of the slit. Two superimposed spectra, *a* and *b*, corresponding to A and B, are then seen through the telescope of the apparatus. With this arrangement the comparison of the brightness of the lights is somewhat doubtful. Trannin therefore interposes between the collimator telescope and the dispersing prism a Foucault's prism, a plate of quartz cut parallel with its principal axis, and a Wollaston prism. (*Journ. der Physik*, v., p. 297.)

**Determination of the Depth of the Sea, by means of the Bathometer, without the use of the Lead.**—C. W. Siemens.—From the *Comptes Rendus*, lxxxiii., p. 780.

**Variations in the Critical Point of Carbonic Acid in Minerals, and Conclusions from these and other Facts.**—W. N. Hartley.—From *Nature*, xv., p. 167.

The Absorptive Power of Bodies for Heat.—M. Aymonnet.—From *Comptes Rendus*, lxxxiii., 971.

New Mode of Examining Thermic Spectra.—M. Aymonnet.—From *Comptes Rendus*, lxxxiii., 1102.

The Rotation of the Plane of Polarisation by Quartz.—MM. J. L. Soret and E. Sarasin.—From *Comptes Rendus*, lxxxiii., 818.

Investigations on the Coefficients of Transpiration.—A. Gouront.—From *Comptes Rendus*, lxxxiii., 1291.

The Atomic Weight and Specific Heat of Glucinum (Beryllium).—J. Emerson Reynolds.—From the *Phil. Mag.*, iii., 38.

Ludlamite, a new Mineral from Cornwall.—F. Field.—From the *Phil. Mag.*, iii., 52.

The Rotary Power of Styrolen.—M. Berthelot.—The author, in opposition to the theoretical views of Van't Hoff, which the latter considered to be verified by experiments performed with a material not quite pure, has again determined the rotation of the plane of polarisation of styrolen. In two samples the rotatory power for the sodium line amounted to  $-3.1^\circ$  and  $-3.4^\circ$ .—*Ann. der Chemie*, ix., p. 53.

Influence of Temperature upon Magnetisation.—J. M. Gaugain.—From *Comptes Rendus*, lxxxii., 1422, and lxxxiii., 661.

Measurements of Resistance by means of the Capillary Electrometer.—G. Lippmann.—*Comptes Rendus*, lxxxiii., 192.

Electro-conduction and Electrolysis of Compounds. Action of the Current of a Battery of 8040 Elements upon Imperfect Liquid Conductors.—L. Bleekrode and Warren de la Rue.—From the *Proceedings of the Royal Society*, xxv., 322.

An Experiment analogous to the Sonorous Flames.—M. Montenat.—From *Comptes Rendus*, lxxxiv., 33.

A new Direct-vision Spectroscope.—H. Schellen.—An account of Hillger's instrument.

Determination of the Poles of Magnets.—R. Benoit.—*Comptes Rendus*, lxxxiv., 76.

Action of Heat upon Closed Circuits containing an Electrolyte.—M. du Moncel.—*Comptes Rendus*, lxxxiv., p. 83.

*Bulletin de la Societe Chimique de Paris,*  
No. 3, Aug. 5, 1877.

Action of Bromine upon Ordinary Pyro-tartaric Acid.—M. E. Bourgoin.—Already noticed.

On Two New Sulph-ureas with Acid Radicals.—M. P. Miquel.—The two new compounds are acetyl naphthyl-sulph-urea, formed by the reaction of naphthylamin dissolved in anhydrous ether with sulphocyanide of acetyl and acetyl-para-cresyl-sulph-urea, which is formed by an analogous reaction, crystallised toluidin being substituted for naphthylamin.

Preparation of the Sulphocyanate of Silicium.—M. P. Miquel.—The author has previously obtained sulphocyanate of silicium by distilling the product resulting from the action of silicic chloride upon dry finely powdered sulphocyanate of lead. He finds it preferable to place the vessel in which the reaction has been accomplished in a paraffin bath heated to  $140^\circ$ . A layer of sulphocyanate of silicium forms on the surface, whilst lead chloride and other solid matters collect at the bottom. After about a quarter of an hour the vessel is sealed and allowed to cool. The liquid layer soon solidifies as a beautiful crystalline mass which is easily separated. The melting-point of silicic sulphocyanate is about  $137^\circ$ .

Action of Heat upon Cyanamid, Dicyano-diamid, and Melamin.—M. E. Drechsel.—If cyanamid is heated until decrepitation begins, and the fire is then withdrawn ammonia is evolved, a little cyanamid is condensed in the

colder parts of the tube, whilst in the warmer part there is formed a liquid ring of dicyano-diamid which rapidly crystallises. A little melamin is obtained as a residue. Dicyano-diamid melts when heated, gives off ammonia, yields a sublimate of almost pure melamin, and leaves a yellow residue. Melamin kept below its point of fusion decrepitates, and gives off white fumes, which condense as a sublimate of unchanged melamin. If melted it climbs up the sides of the tube, and is decomposed as Liebig has shown. Melamin dissolves in alcohol in appreciable quantities, and crystallises out on cooling. It dissolves also in hot glycerin. The sulphate of melamin crystallises sometimes with  $1\frac{1}{2}H_2O$ , and sometimes with  $2H_2O$ . The author has not been able to trace the circumstances which lead to the formation of one or the other of these salts.—*Journal für Praktische Chemie*, xiii., 330.

Action of Chloride of Benzoyl upon Cyanamid and Sodium-Cyanamid.—M. G. Gerlich.—This paper, taken from the *Journal für Praktische Chemie*, cannot be usefully condensed into the space at our disposal.

On Isomalic Acid.—M. M. Schmoeger.—The author obtains this acid by treating mono-bromo-isosuccinic acid with silver oxide. The acid isomalate of calcium forms a vitreous mass; the neutral lead salt is an amorphous precipitate.—*Journal für Praktische Chemie*, xiv., 77.

Synthesis of Polybasic Acids by means of Salicylic and Carbonic Acids.—M. H. Ost.—This paper, taken from the *Journal für Praktische Chemie*, xiv., 93, does not admit of useful abstraction.

On Phlorizin and Phloretin.—M. J. Loewe.—The author finds that phlorizin contains  $C=52.38$  and  $H=5.74$ , corresponding to the formula  $C_{23}H_{30}O_{14}$ . Phloretin contains  $C=64.36$  and  $H=4.54$ , a composition agreeing with the formula  $C_{17}H_{14}O_6$ .—*Zeitschrift für Anal. Chemie*.

Method for the Volumetric Determination of Zinc.—M. C. Fahlberg.—The author proposes to titrate zinc in a hydrochloric solution with ferrocyanide of potassium, and uses as indicator a solution of uranic nitrate, which, as soon as an excess of ferrocyanide appears in the solution, gives a brown precipitate, or at least a brown colouration. Manganese and alumina do not interfere. After dissolving the ore in aqua-regia, all metals precipitable by sulphuretted hydrogen, and also iron, are removed by the ordinary methods. The ammoniacal solution containing the zinc is neutralised with hydrochloric acid, and then acidulated with 10 to 15 c.c. of the same acid at sp. gr. 1.12. This solution is titrated with a solution of ferrocyanide of which 1 c.c. represents 0.01 grm. of zinc; the final reaction is performed on a porcelain plate upon which a series of drops of a solution of uranium nitrate have been placed. The results are exact to 0.2 or 0.3 per cent.—*Zeitschrift für Anal. Chemie*, xiii., 379.

Attack of Chrome Iron.—M. R. Kayser.—The author proposes to attack this ore with a mixture of 2 parts of carbonate of soda and 1 part pure hydrate of lime. The mixture is maintained for half an hour at bright redness in an open crucible with frequent stirring. The chromate formed may be easily extracted in boiling water.—*Zeitschrift für Anal. Chemie*, xv. 187.

New Method of Determining Phosphorus, Arsenic, Sulphur, Chlorine, Bromine, and Iodine in Organic Bodies.—M. G. Brugelmann.

Determination of Sulphur in Coal Gas.—These two papers are reserved for insertion in full.

Extraction of a Red Colouring Liquid from the Marc of Grapes.—A. Carpené.—The author operates upon the mass left on the distillation of alcohol from spent grapes. The colour resembles ammoniacal cochineal, and being soluble in dilute alcohol may be used for colouring wines.

Nos. 4 and 5, Sept. 5, 1877.

On a New Acid Product contained in the Leaves of Certain Vegetables.—M. Ch. Bougarel.—The acid

in question was found in the leaves of certain rosaceous plants and of the common laurel. Its composition is:—Carbon, 69.08; hydrogen, 10.36; oxygen, 20.55; total, 99.99—corresponding to the formula  $C_{72}H_{64}O_{16}$ . The author names it provisionally phyllic acid, and is engaged with the preparation and analysis of its salts.

**Contribution to the History of the so-called Catalytic Action of Platinum.**—M. E. von Meyer.—The author concludes from his experiments that De la Rive's theory of the action of platinum upon mixtures of oxygen and of combustible gases is inadmissible.—*Journal für Praktische Chemie*, xiv. 124.

**Influence of Pressure upon the Phenomena of Combustion.**—M. V. Wartha.—The author has burnt stearine candles in the air at an ordinary pressure and at a pressure of 1.95 atmospheres in a large iron chest, determining in each case the quantity of matter burnt per hour. Those burning at the common pressure had a flame 4.5 to 6 centimetres in height, and consumed hourly from 9.34 to 10.70 grms. of stearic acid. At the increased pressure the flame was very sooty, of a yellowish-red, and from 9 to 12 centimetres in height, but the quantity of stearic acid consumed was only 7.99 to 9.11 grms. He burnt also candles at very low pressures, as, e.g., 9 centimetres of mercury. The flame was much increased, lost its brightness, and took a greenish-blue colour. Three portions could be plainly distinguished; the central part of a greenish-blue, quite detached from the wick, and having the form of a cap; this part is enveloped in a violet mantle, and this again in a second violet mantle so pale as to be scarcely visible.—*Journal für Praktische Chemie*, xiv., 84.

**Capacity of Saturation of Manganous Acid.**—M. Al. Gorgen.—The author concludes that the acid is bibasic (or, if atomic weights are used instead of equivalents, tetrabasic).—*Répertoire de Chemie Pure*, iv., 415.

## University of Durham College of Physical SCIENCE, Newcastle-on-Tyne.

Seventh Session.

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# THE CHEMICAL NEWS.

VOL. XXXVI. No. 932.

## PROPOSED TESTS FOR CARBOLIC AND NITRIC ACIDS.

By DAVID LINDO.

30 drops of a cooled mixture composed of 2 parts concentrated sulphuric acid, and one of water by measure, are added to 8 or 10 drops of an aqueous solution of carboic acid (say 15 grains to an ounce of water) contained in a small porcelain dish, no colour is observed; but on adding 1 or 2 drops of nitric acid, a deep brown colour is immediately developed, which on agitating the vessel, quickly changes to a beautiful red.

I am not aware that this reaction has been noticed before, and would propose it as a test for carboic acid.

With certain nitrates in solution, the reaction is far more sensitive than with nitric acid. The solutions should not be too strong.

It is advisable to dilute the sulphuric acid as above in testing with nitric acid, as the colours are produced with more certainty than when concentrated sulphuric acid is employed, but the latter should be used when testing with nitrates.

With 8 or 10 drops of carboic solution, 5 grains to an ounce of water, a very beautiful reaction is obtained with a drop or two of nitric acid.

With 8 or 10 drops of carboic solution, 2 grains to the ounce, the colours are easily produced with 2 or 3 drops of solution of nitrate of silver or proto-nitrate of mercury, not too strong.

With a little care the reactions can be obtained with one drop of these carboic solutions.

Nitrate of silver and proto-nitrate of mercury with careful manipulation can be made to reveal the presence of carboic acid in a solution of 1 grain in 10 ounces of water; but of this dilute solution at least 30 drops must be used, mixed with about 90 drops of concentrated sulphuric acid. After adding the test fluid, the dish should be left at rest for a little, and then gently shaken. The brown colour is rarely observed with these weak solutions.

In testing solutions of ordinary strength, place 8 or 10 drops in a small porcelain dish, and add about 30 drops of concentrated sulphuric acid if you are going to test with a nitrate. Move the vessel about to mix its contents, and allow 2 or 3 drops of the test fluid to flow down the side of the dish into the hot mixture. On giving the vessel a rotatory motion, the final colour is soon obtained, which with most nitrates is a deep magenta, of great purity and beauty if the carboic solution was tolerably strong, and the sulphuric acid employed colourless. If the colour is not very full at first, a little more of the carboic solution will bring it up.

With weak carboic solutions, the final, and sometimes the only colour observed, is purple or pink.

Proto-nitrate of mercury gives a very bright yellow at first, changing to brown, and then to red, which makes it an excellent test. This yellow colour is a highly sensitive reaction, and can be plainly seen with carboic solutions so weak that the final pink is barely or no longer discernible.

The carboic acid used in these experiments was Calvert's No. 1, and the solutions fresh. The sulphuric acid employed was colourless.

These reactions naturally suggest the use of a mixture of carboic and sulphuric acids as a test for nitric acid. A carboic solution, 5 grains to an ounce of water, answers well for the purpose, and may be taken as a standard solution in testing for nitric acid in the nitrates. It

should be used pretty fresh; the more so the better for all except highly dilute solutions of nitrates.

Very much stronger carboic solutions will often fail to give the reaction if the solution of nitrates is highly dilute.

When the solution is going to be used, 8 or 10 drops are placed in a small porcelain basin, and mixed with 30 drops of concentrated sulphuric acid; 2 or 3 drops of the fluid to be tested are then added to the hot mixture.

The following solutions of nitrate of potash were tested by this method:—

- 1 grain of nitre in 1 ounce of water—reaction excellent.
- 1 grain of nitre in 2 ounces of water—reaction very good.
- 1 grain of nitre in 4 ounces of water—reaction still good.
- 1 grain of nitre in 6 ounces of water—reaction uncertain.

Sometimes a convenient way of applying the test is to dissolve the suspected nitrate in the carboic solution, and then add sulphuric acid.

I have not found this reaction produced by any other substance but nitric acid, and trust it may prove a useful addition to our tests for this acid.

The subject seems worthy of further investigation, and as yet I have not had time for this. I shall be glad if it proves sufficiently interesting to induce others to follow it up.

Falmouth, Jamaica, September 3, 1877.

## ON THE SPECTRUM OF THE METAL DAVYUM.

By SERGIUS KERN, St. Petersburg.

THE author has examined the spectrum given by davyum. The metal, in powder, was placed between the carbon points of an electric lamp. The spectroscopie in the hands of the author was not powerful enough to show distinctly the secondary lines, but the principal lines were seen very well.

The following are the lines of davyum seen well in the instrument:—

FRAUENHOFER'S LINES.			
A.	17.3	F.	90.0
a.	22.6		92.0
	24.3 Da		92.5
B.	28.0		93.3
	31.6 Da		93.6
	32.5		116.5
C.	34.0		122.0
	36.6	G.	127.5
	37.3 Da		135.3
	40.0		150.0
D.	50.0		157.0
	53.0		157.5
	54.5 Da		160.3
	55.3	H.	162.0
E.	71.0	H.	166.0
b.	75.4		
	84.0		
	84.8 Da		

It must be mentioned that further researches on davyum will be made when a sufficient quantity of the metal is extracted.

Obouchoff Steel Works.

## ON THE UNIFORMITY OF THE PRECIPITATE IN WHICH DAVYUM WAS FOUND.

By SERGIUS KERN, St. Petersburg.

THE precipitate in which a new metal was supposed to exist, and which was obtained by the action of ammonium chloride and nitrate (CHEM. NEWS, vol. xxxvi., p. 4),

was reduced, as has been already mentioned, to metallic state by ignition. The resulting grey powder, in order to ascertain that a new metal indeed was obtained, has been submitted to the following tests:—

1. Potassium hydroxide in a davyum chloride solution produces a precipitate of a light yellow colour, insoluble in an excess of the reagent, and easily soluble in acids, even in acetic acid. Alcohol has no action on davyum solutions.
2. Potassium nitrite ( $\text{KNO}_2$ ), warm, gives no precipitate; in the cold, a light silky red-brownish precipitate. The precipitate on being dried is not crystalline, but has an amorphous structure.
3. The reaction with potassium sulphocyanide belongs to davyum, as pure ruthenium gives no reaction of such kind. Prof. Bunsen ascribes this reaction to ruthenium, when it is due only to the impurity of the latter metal (N. Menchoutkine, "Analytical Chemistry," p. 211). There was no uranium or iron present.

These reactions are the most characteristic of the metal davyum.

Obouchoff Steel Works.

ON  
XANTHATE OF POTASSIUM  
EMPLOYED FOR THE DETERMINATION OF  
SULPHIDE OF CARBON, SALTS OF COPPER  
AND CAUSTIC ALKALIES,  
EVEN IN  
PRESENCE OF ALKALINE CARBONATES AND  
SULPHURETTED COMPOUNDS.

By M. E. A. GRETE.

M. VOGEL has already recommended the reaction of the xanthates on salts of copper for the qualitative detection of the sulphide of carbon in gas. This reaction may also serve for its determination. For this purpose we transform the sulphide of carbon into xanthate of potassium, which we titrate by the aid of a normal solution of sulphate of copper at one-fiftieth, containing, consequently, 0.0012672 grm. of copper per cubic centimetre, which corresponds to 0.006404 grm. xanthate of potassium and to 0.00304  $\text{CS}_2$ . We may also employ the normal liquid at the twentieth, 1 c.c. = 0.003168 grm. Cu. To obtain this liquid we weigh out 3.168 grms. sulphate of copper, dissolve it in water, and add salt of Seignette and carbonate of soda until the precipitate is re-dissolved, and dilute then to 1 litre. The presence of ammonia and of caustic alkalis must be avoided. The precipitate of xanthate of copper is deposited very easily by agitation, and the end of the reaction is known by the absence of turbidity when we add a further drop of cupric liquid. Xanthate of potassium containing an excess of caustic alkali: we must saturate this with cream of tartar or, better still, bicarbonate of soda.

*Determination of Copper.*—Inversely, the xanthate of potassium may serve for determining copper. To this end we dissolve a known weight of the salt of copper to be analysed in a mixture of salt of Seignette and carbonate of soda, then we drop in a standard solution of xanthate of potassium, of which we must verify each time the strength with the standard solution of copper. The results are very exact.

*Determination of Caustic Alkalies.*—As each atom of copper precipitated in the state of xanthate sets free 2 molecules of caustic alkali, the process above permits the evaluation of the latter, even in presence of carbonates and of sulphides. The substance to be analysed, as dehydrated as possible, being dissolved in absolute alcohol, we treat it with sulphide of carbon; the caustic alkali alone

transforms instantaneously this latter into xanthate. The alkaline sulphides act the same. To account for this, we precipitate at first with the copper liquid until the precipitation of the sulphide and of the sulpho-carbonate, the conclusion of which is perceived by the use of a lead-paper. We complete then the titration, and each atom of copper precipitated indicates the presence of 2KHO or  $\text{K}_2\text{O}$  in the analysis.—*Chemisches Centralblatt*, ix., 921.

PYRO-CHEMICAL ESSAYS.\*

By Lieut.-Col. W. A. ROSS, late R.A.

II. *Agalmatolite*.

- (1.) *Appearance*; yellowish white, waxy.
- (2.) Quite soft in crushing, and stuck to the polished agate. This is a peculiarity of greasy-feeling minerals, such as *soapstone*, *steatite*, *sepiolite*, &c., and is a sure indication of combined or chemical water and of silica.
- (3.) Heated on aluminium plate, a fragment became white and chalky on the surface, and became blue after heating with a drop of cobalt solution.
- (4.) A fragment held above the base of the gas pyrocone did not change its blue colour, but at the point gave out a slight violet pyrochrome,† showing a small quantity of potash.
- (5.) In a boric acid bead, B.B., the fine powder showed only rounded white fragments like those of pure alumina; the green boric acid pyrochrome being unchanged shows that if there is any soda present it must be under 1 per cent.
- (6.) In a bead composed of equal parts of boric and phosphoric acids, B.B., by the fine powder white opaque fragments were still shown, but rather more pointed than before.
- (7.) In a bead of phosphoric acid, B.B., the fine powder still showed white fragments, which, however, became much reduced in size and more crystalline in appearance, like pieces of loaf-sugar. The bead itself became gelatinous and reddish.
- (8.) Boiled bead (7) in a Berlin capsule; an unclear or milky solution (a) and a white residue (b). Allowed to stand till clear, and decanted (a), at first gave no precipitate with sodium carbonate or hydrate solution, but as this reagent re-dissolves its aluminous precipitate (Fresenius), and the liquid was found by test-paper to be strongly alkaline, it was acidulated with phosphoric acid, when a drop of sodium carbonate gave a white flocculent precipitate.

*Collection of Evidence.*

Here, although the operations (1) to (5) showed that we had an alkaline aluminium silicate as in the case of *adularia*, the boric acid test (5) gave quite a different reaction, and at this stage the operator might have reasonably concluded, except from (2), that he had only alumina with a small quantity of potash present, but as that would be rapidly dissolved in phosphoric acid, he saw from (7) that the mineral is an aluminium silicate with combined water; from (4) that it contains no lime; and from (6) that there is probably no iron. The milky solution (8) was probably due to suspended silica.

III. *Albite*.

- (1.) Fine powder in a boric acid bead, B.B., gave an icy mass; an alkaline silicate without water.
- (2.) Added phosphoric acid to bead (1) until the ensuing opalescence became clear, in order to save the time of making a fresh bead, when I found that the siliceous mass

\* It is scarcely necessary to state that these examinations are entirely qualitative.

† I.e., coloured flame.

was completely dissolved. On adding B.B. fresh *albite* powder a bluish transparent mass appeared, which gradually became quite transparent at the point of the "flame" as the alumina dissolved.

(3.) Boiled bead (2) in a Berlin capsule, when the solution (which was slightly milky at first) gave with sodium carbonate a slight, white, slowly-settling precipitate. The residue gave a transparent mass in boro-phosphoric acid, with some brownish specks; probably a minute trace of iron.

(4.) A fragment held at its base tinged a blue gas pyrocone slightly violet; trace of potash; at its point strongly orange; soda; free soda.

#### Collection of Evidence.

An alkaline silicate of aluminium, with no lime, containing soda with a trace of potash.

#### IV. *Almandine*.

*Appearance*.—Transparent, brownish red, violetish red by transmitted light.

(1.) Crushed in (a) forceps (rather easily; hardness not greater than quartz), and then between agates, the fine powder was of a reddish colour.

(2.) The fine powder in a bead of boric acid, B.B., afforded (a) a number of white opaque balls like snowballs; magnesia. (b) One black ball covered with creamy matter; due to some ball-forming metallic oxide, as iron, manganese, cobalt, or copper. (c) A large quantity of creamy yellowish white matter diffused through the bead: both silica and alumina behave in this way when decomposed, B.B., by lime or magnesia.

#### Collection of Evidence.

We see by operation (2) that this mineral is not the *almandine garnet*, which I had at first supposed it to be by a reference to Bristow, "Glossary" Art. "Almandine," but the *almandine* variety of *spinel*. The black ball, therefore, was probably iron sesquioxide, and the object now was to determine this question, and if the streaky or creamy matter was due to alumina.

(3.) Added crystals of phosphoric acid, B.B., to (2) bead until the opalescence which they created had been redissolved to a clear bead; the balls and all contained matter was dissolved, and the bead became transparent, but bright yellow hot, colourless cold. This is the reaction of a small quantity of iron.

(4.) Trace of almandine to (3) bead B.B. Effervescence (?), minute brownish black balls covered with streaky white matter. After strong heating the balls were dissolved, the bead remaining transparent, but gelatinous and yellowish.

(5.) Added a third trace of *almandine* to (4) bead B.B. A number of brownish black fragments; no balls; bead nearly opaque, and yellowish white with streaky matter.

(6.) Crushed (5) bead in (a) forceps, and boiled the powder in a Berlin capsule. (a) Clear solution. (b) Greenish white residue.

(7.) (a) Afforded with a drop of sodium hydrate solution a precipitate which re-dissolved, but on rendering the fluid neutral with a few crystals of boric acid a white flocculent precipitate; aluminium hydrate? (b) Gave in a bead of boric acid, B.B., olive green balls with a slight white matter clinging round them.

(8.) In a bead of boro-phosphoric acid fresh *almandine* powder gave several minute brownish black balls covered with streaky white matter, which were not dissolved by strong heating like those of (4).

(9.) In a bead of boric acid, B.B., fresh *almandine* powder gave, as before, white streaky matter, white opaque balls, and brownish black balls covered with white matter, which last were extracted by boiling, crushed, and the powder treated B.B. in a fresh bead of boric acid, when black balls appeared without white matter round them, and, in addition, white opaque balls like those formed by magnesia.

#### Collection of Evidence.

We have now clear proof that the mineral consists of alumina, magnesia, oxide of iron, and—apparently from the green matter seen in (6) and (7)—chromium sesquioxide.

(To be continued.)

### NOTES OF WORK BY STUDENTS OF PRACTICAL CHEMISTRY IN THE LABORATORY OF THE UNIVERSITY OF VIRGINIA. No. VI.

Communicated by J. W. MALLET,  
Professor of General and Applied Chemistry in the University.

#### (1.) *Experiments on the Direct Reduction of Silver from its Sulphide by Mercury in the Amalgamation Process.* By R. SEGURA, of the City of Mexico.

It is remarkable that there still exists so much uncertainty as to the theory of the amalgamation process for the reduction of silver ores, while the process itself is practised on so great a scale, and has in one form been in use for more than three hundred years. Especially does doubt hang over the question of the purpose served by the "chemicals" added to the ore, water, and mercury—such as common salt, sulphate of copper, roasted copper pyrites, &c.—and by the iron of the pans in which the process is carried out in Nevada and elsewhere. These additions are made in the most varied way as to materials and quantities, some managers ascribing an almost magical importance to them, while others reduce their amount to almost nothing or discard them altogether. As the ores worked are themselves of varied character, and the work is frequently unchecked by assay, it is not easy to obtain direct evidence of the value of the practice in use at any particular set of works. Where mercury alone has been used, the upholders of the value of chemicals claim that the amalgam only contains such silver as existed in the metallic state, or as chloride or bromide, in the ore, while sulphides are supposed to be left undecomposed and lost in the tailings. In various books it is directly stated—as, for instance, in the article on the extraction of silver in "Watts's Dictionary of Chemistry" (vol. v., p. 281), that silver sulphide is not acted on by mercury.

This one point being obviously easy to settle by direct experiment, Senor Segura undertook to test it. He unfortunately lost the larger portion of his notes before transcribing them, and was therefore only able to reproduce the main results. As it seemed likely that much would depend upon the state of sub-division of the silver sulphide, it was used in three different forms—viz., in the finely pulverulent condition, as thrown down by hydro-sulphuric acid from a solution of the nitrate; massive, as obtained by fusing the precipitated and dried sulphide; and as native argentite (from Freiburg, in Saxony).

A. 1 part precipitated silver sulphide, 10 parts pure mercury, and 5 parts water, were triturated together in a porcelain mortar for two hours. At the end of that time one-fifth to one-third of the whole quantity of silver present was found in the state of amalgam, and a corresponding amount of mercuric sulphide had been formed. When the grinding was continued for six hours the same change had gone further, but the precise figures obtained have been lost.

B. 1 part of artificial fused silver sulphide, 10 parts mercury, 5 to 10 parts water, and about 20 parts of siliceous sand (to aid in pulverising the sectile sulphide) were triturated as above. It seemed that grinding for something like two hours was necessary to reduce the sulphide to so fine a state of division that the mercury readily

attacked it, but on continuing the grinding further the silver amalgam and mercuric sulphide formed as in (A).

C. 1 part native argentite, 10 parts mercury, 5 to 10 parts water, and about 20 parts of quartz sand, gave essentially the same result as in (B).

In order to see whether finely-divided metallic iron would aid in reducing the silver, some experiments were also made with addition of the "iron reduced by hydrogen" of medical use.

D. 1 part of precipitated silver sulphide, 10 parts mercury, 5 to 10 parts water, and 1 part of Quevenne's iron, were ground together. The result was as in (A), no advantage seeming to be gained by the addition of the iron, nor was there any change when it was used in much larger proportion. This result, of course, does not touch the question of the value of iron when common salt and cupric sulphate are also used.

In all these experiments the amalgamation was found to occur much more readily with a small than a large quantity of water, so that the consistence of the mass was that of a soft paste, but not thoroughly liquid—a point which may, perhaps, be worth notice in operations upon the large scale, though the question of increased power required for grinding would have also to be considered. In one or two experiments the mercury would not run together well, and could not be directly recovered by simple washing, but it was easy to separate and determine the metallic silver and mercury by dilute nitric acid, which left the mercuric sulphide unattacked.

(2.) *Experiment as to the Solubility, or Very Long Continued Suspension, of Mercury in Water.* By R. SEGURA.

That very large quantities of mercury, as well as of the precious metals, are annually lost at amalgamation works is well known. In the Spanish-American process, common salt being used, and silver chloride supposed to be formed and reduced to the metallic state by mercury, this latter metal is assumed to be washed away as calomel with the earthy portions of the slime. The experiments just recorded show that it may also be carried off as sulphide. But there is good reason for supposing that a further portion is swept away as metallic mercury in globules so minute as to remain suspended for a very long time; so long, indeed, that some observers have been inclined to suspect actual solution, either of the metal or one of its oxides.

Reports have often been made from the amalgamation works of California and Nevada of water, apparently perfectly clear, taken from the flumes, or even from river-courses, at long distances below the mills, in which if pieces of sheet-copper, or the iron nails of wood-work, be allowed to lie for months or years, their surface becomes heavily amalgamated, the deposition of ounces and even pounds of mercury having been noticed.

It seemed possible that the effect of the long-continued grinding of mercury with the ores of silver and gold might be imitated in the laboratory by substituting for the metal in mass the "mercury with chalk" or "with magnesia" of the pharmacopœias, and that on treating this with water some evidence might be obtained of the taking up of quicksilver in a form which would not separate mechanically, at any rate for a long time. Senor Segura purified some clear commercial mercury by protracted warming and shaking with dilute nitric acid, washing, drying, and slowly distilling it in a glass retort. 10 grms. of mercury thus purified was thoroughly extinguished by trituration with 16 grms. of pure precipitated calcium carbonate. The resulting powder was twice boiled with 1 litre of pure water, and these portions of water rejected. It was then boiled with more distilled water in portions of 2 litres at a time in glass vessels, and allowed after each boiling to settle. The water decanted off was filtered through close French paper free from metallic oxides, allowed to stand for forty-eight hours, and the middle portion in the vessel (rejecting the upper and lower strata) carefully syphoned

off. 10 litres of water, thus saturated with whatever mercury could be taken up and retained under the circumstances, was evaporated with exclusion of dust, adding at first a few drops of nitric acid, and toward the end a like quantity of hydrochloric acid, and finishing the evaporation to dryness on the water-bath. The almost invisible residue, treated with a few drops of water and a drop or two of solution of hydro-sulphuric acid, gave a slight brown precipitate, which seemed less in amount than that obtained from a solution of 1 milligram. of mercury as mercuric chloride in the same bulk of water.

So that, as far as this one experiment goes, it appears to confirm the possibility of very minute traces of mercury being thus taken up by water, but to an extent, under the conditions named, of less than 1 part in 10,000,000.

(3.) *Analysis of a New Mineral containing Niobium, from Amhurst Co., Virginia.* By WM. G. BROWN, of Albemarle Co., Va.

A rare mineral, of which small pieces occur along with allanite, the latter quite abundant, in the county named, I have described in the *American Journal of Science* as a new species. Its chemical analysis was made by Mr. Brown, under my direction. It proved by no means an easy task, some of the separations having to be repeated several times before satisfactory results were obtained. The method adopted was as follows:—

The finely pulverised mineral was fused at a low red-heat in a platinum crucible with eight or ten times its weight of acid potassium sulphate until completely decomposed. The fused mass was left to soak in cold water,\* strongly acidulated with hydrochloric acid, until it could be readily crushed with a stirring-rod. The watery solution was poured off, the insoluble metallic acids (niobic, tantallic, tungstic, and stannic) with a little iron washed several times by decantation with hot water, caught on a filter, and carefully washed. While still moist they were digested with yellow ammonium sulphide, which was filtered off, and the residue washed with dilute ammonium sulphide, then separately with dilute hydrochloric acid, and finally with water, dried, ignited, and weighed. The sulphides of tin and tungsten were precipitated from the ammonium sulphide solution by hydrochloric acid and weighed together, then fused with sodium carbonate, the mass treated with dilute hydrochloric acid, and the tin re-precipitated as sulphide, converted into oxide, and weighed. The tungsten was obtained by difference. In the insoluble metallic acids the presence of tantalum was ascertained, but it proved to exist in too small quantity (less than a twelfth of the niobium) to admit of accurate separation by Marignac's process, which was the one used, viz., by potassium acid fluoride in solution of proper strength of the mixed fluorides. To the filtered solution of the original fused mass was added the iron dissolved out from the metallic acids, nitric acid was added, and, after heating, ammonium hydrate. The precipitate obtained was filtered off and washed, re-dissolved in hydrochloric acid, again precipitated by ammonia and thoroughly washed, once more dissolved in a minimum of hydrochloric acid, and an excess of oxalic acid added. The precipitate produced was ignited, dissolved in hydrochloric acid, largely diluted with water, and boiled with sodium thio-sulphate to precipitate zirconium, this precipitate being then filtered off, ignited and weighed.† The filtrate therefrom was evaporated to a small bulk, and treated with an excess of boiling saturated solution of potassium sulphate and a few solid crystals of the same salt. After becoming quite cold the precipitate was filtered off, and washed with cold saturated solution of potassium sulphate, then dissolved in boiling water with a little hydrochloric acid, and the cerium metals thrown down

\* Employed in order to admit of titanium being detected and determined in the solution. The absence of this metal, however, was proved.

† The metallic acids were also examined for zirconium; and thorium was carefully tested for, but was not detected.

as hydrates. The filtrate from the double sulphates was diluted, and yttrium and erbium also thrown down as hydrates. The lanthanum was separated from cerium and didymium by means of yellow mercuric oxide and potassium permanganate (Winkler's method), and didymium and cerium from one another by lead dioxide and nitric acid (Gibbs). A weighed portion of the yttrium and erbium oxides was treated with sulphuric acid, so as to produce the corresponding sulphates. The change of weight showed that erbium was almost exclusively present. The erbium absorption-spectrum was obtained with great distinctness with the solution. The filtrate from the oxalates thrown down in the early portion of the analysis was evaporated to dryness in a platinum dish, the residue ignited and treated with hydrochloric acid, which dissolved out iron and uranium with a little glucinum, leaving most of the last-named metal as difficultly soluble oxide. The solution was precipitated by ammonia, the precipitate ignited and weighed, treated with hydrochloric and nitric acids, leaving a little more glucina, and iron and uranium separated by ammonium carbonate. These metals were proved to exist as ferrous and uranous compounds in the mineral. The filtrate from the precipitation by ammonium hydrate was tested with ammonium sulphide, and lime and magnesia determined as usual. The alkalis were determined in a separate portion of the mineral, decomposed slowly but completely by heating with strong sulphuric acid. The water was expelled by heating over the flame of a Bunsen lamp, collected, and directly weighed. Considerable quantities of the mineral were brought into solution, and used in the determination of the minor constituents. The results were the following:—

Nb <sub>2</sub> O <sub>5</sub> }	.. .. .	48.66	{ About 2 p.c. may be assumed to be Ta <sub>2</sub> O <sub>5</sub> .
Ta <sub>2</sub> O <sub>5</sub> }	.. .. .	0.16	
WO <sub>3</sub> ..	.. .. .	0.08	
SnO <sub>2</sub> ..	.. .. .	2.09	
ZnO <sub>2</sub> ..	.. .. .	27.94	{ About 1 p.c. may be assumed to be Y <sub>2</sub> O <sub>3</sub> .
Eb <sub>2</sub> O <sub>3</sub> }	.. .. .	1.37	
Y <sub>2</sub> O <sub>3</sub> }	.. .. .	3.92	
*Ce <sub>2</sub> O <sub>3</sub> ..	.. .. .	4.06	
†La <sub>2</sub> O <sub>3</sub> ..	.. .. .	3.47	
‡Di <sub>2</sub> O <sub>3</sub> ..	.. .. .	trace	
UO ..	.. .. .	2.04	
MnO ..	.. .. .	0.62	
FeO ..	.. .. .	0.05	
BeO ..	.. .. .	2.61	
MgO ..	.. .. .	trace	
CaO ..	.. .. .	0.16	
Li <sub>2</sub> O ..	.. .. .	0.06	
Na <sub>2</sub> O ..	.. .. .	trace	
K <sub>2</sub> O ..	.. .. .	3.19	
F ..	.. .. .		
H <sub>2</sub> O ..	.. .. .		

100.48

(To be continued.)

## TRANSVERSE ABSORPTION OF LIGHT.

By W. ACKROYD.

IN a former paper (CHEMICAL NEWS, vol. xxxiv., pp. 75, 77) that change of selective absorption was dealt with which is seen upon heating certain coloured bodies. Elsewhere I have shown that it is convenient to distinguish between this aspect of absorption and that where change of colour is observed without structural alterations, as, *e.g.*, where the strength of a coloured solu-

\* Cerous oxide, but with Cléve's formulæ and atomic weights for this and the corresponding lanthanum and didymium oxides.

† Containing a trace of Di<sub>2</sub>O<sub>3</sub>.

‡ Containing a trace of Ce<sub>2</sub>O<sub>3</sub>.

§ Philosophical Magazine for December, 1876; and Journal of the Physical Society, vol. ii., pp. 110 to 118.

tion is increased, or a longer stratum of it looked through, for in both these latter instances a deepening of colour is observed. To these different manifestations of probably the same general phenomenon the names of *structural* and *transverse* absorption were applied, and it is with the latter that the present paper deals.

Some consideration of the subject will show that for its exhaustive study it seems necessary to ascertain the absorptive effects (1) of varying the stratum length of the coloured solution, whilst the strength is kept constant; and (2) of varying its strength whilst the stratum-length remains the same. By stratum-length I mean the thickness of solution traversed by a beam of light.

Two series of experiments were therefore commenced, but it was soon found that only one was necessary by my arriving at the following simple principle:—

§1. A constant number of molecules of a substance when similarly aggregated produce the same amount of transverse absorption.—Thus if we take two solutions of permanganate of potash, one strong and the other weak, since we employ the same solvent in each case there is presumably no difference in the permanganate's state of aggregation in the weak and strong solutions. Now if one contains  $x$  grm. of salt

per c.c. and the other say  $\frac{x}{2}$  grm. per c.c., then a stratum-length of 3 centimetres of the former gives the same absorptive effect as 6 centimetres of the latter, for in each case a rectangular bundle of rays, 1 square centimetre in section, is acted upon by  $3x$  grms. of the salt—

$$\left(3x = 6 \frac{x}{2}\right).$$

This law is at the foundation of colorimetric methods of quantitative analysis; I believe, however, that it has not been applied hitherto to abstract science, and I shall refer to it as *the principle of constancy of absorption*.

§2. Extension of the Principle of Constancy of Absorption.—It appeared to me possible that a solution of a body might give the same amount of absorption as the solid itself of a thickness corresponding to its quantity in the menstruum, if in the latter its state of aggregation of the parts which affect light were unaltered or only slightly so. Plates of bichromate of potash were therefore made by rubbing down under a slow stream of water, and then washing with absolute alcohol. Parallelism of the surface having been ensured the thickness of the plate was ascertained by means of a micrometer screw reading to 0.005 m.m.

Now, given the thickness of the solid in millimetres the weight in grms. of a square centimetre of it is readily obtained, for it is the product of the thickness into 1.10th the sp. gr. number.\* Again if in standardising our solutions we still keep to the metric system, the weight of this square centimetre of solid divided by the strength of the solution in grms. per c.c. will give the number of c.c. which contain an equal weight of the body in solution, or what is equivalent, the stratum-length in centimetres, which ought to give the same absorptive effect as the solid.

A couple of bichromate of potash plates gave the following figures, its sp. gr. being taken as 2.617:—

Plate.	Thickness in Millimetres.	Weight in Grms. of a Square Centimetre
1	1.51	0.3951
2	0.71	0.1858

No. 1 plate equalled in absorptive effect 16 centimetres of a solution containing 0.02458 grm. bichromate per c.c., since—

$$16 \times 0.02458 = 0.3932$$

No. 2 plate equally 6 centimetres of solution of strength 0.0309 grm. per c.c., since—

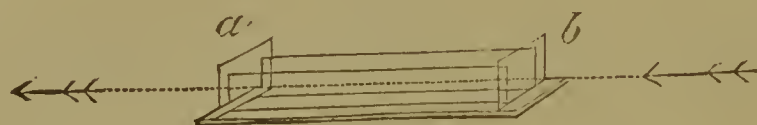
$$6 \times 0.0309 = 0.1854.$$

\* Let the reader here bear in mind that the sp. gr. number is the weight in grms. of a c.c. of the substance.

Similar results were obtained in experiments comparing plates of cupric sulphate with solutions of that body.

§3. *New Method of Observation.*—From the foregoing results it is evident that only absorption experiments of the nature mentioned in §1 (1) need be performed, since data obtained in this manner will furnish one with any information required as to the effect when the strength is varied and the stratum-length kept constant. An accurate quantitative method was now required. A modification of Gladstone's prism-trough qualitative method seemed to me most desirable. For quantitative purposes, however, it was necessary to eliminate the dispersion introduced by a wedge-cell, and, moreover, to have some device whereby weak solutions of known strength could readily be used. These ends were attained by the method now to be described in detail.

FIG. 1.



Trough-cells of glass were made of various lengths and of about 1 square centimetre in cross section, or even less for the economy of the solutions studied. Their lengths in centimetres were as follows:—

20, 10, 10, 5, 2, 1, 1, 1.

Fig. 1 is a sketch of one of them. With such a series any stratum-length of solution could be interposed in the path of the beam up to 50 centimetres.

It was found necessary to have the ends at *a* and *b* fig. 1 of thin microscopic glass thereby reducing the absorption at the blue end of the spectrum to a minimum. It is likewise convenient to have two sets of such cells the one being cemented with marine glue for aqueous solutions, and the other with ordinary glue for certain solutions in which marine glue would be soluble. In working, the cells are placed in a train upon a small wooden platform, with the source of light at one end and the spectroscopic slit at the other. The spectroscope used was one of Browning's, with dense glass prism and movable telescope, to which is attached a vernier enabling one to read to 1 inch of arc. Where necessary the indications of the instrument have been reduced to wavelengths by an interpolation curve constructed from data obtained by careful observation of the solar spectrum.

Now, in Gladstone's qualitative method,\* where a wedge-cell containing vessel is employed and a prism to analyse the transmitted light, a rectangular spectrum is obtained with a wedge of absorption. In my quantitative method the representation of this rectangular spectrum with its wedge or curve of absorption is obtained by taking the cell-lengths as ordinates and the spectroscopic readings as abscissæ.

Fig. 2, which gives the results obtained with two strengths of bichromate of potash, will serve to illustrate the foregoing remarks. Each cross marks the termination of the absorption band extending from the ultra-violet. It will be observed (1) that by this method we eliminate dispersion, the light passing in the direction of the arrows in fig. 1, at right angles to the absorbing medium; and (2) that the results are quantitative.

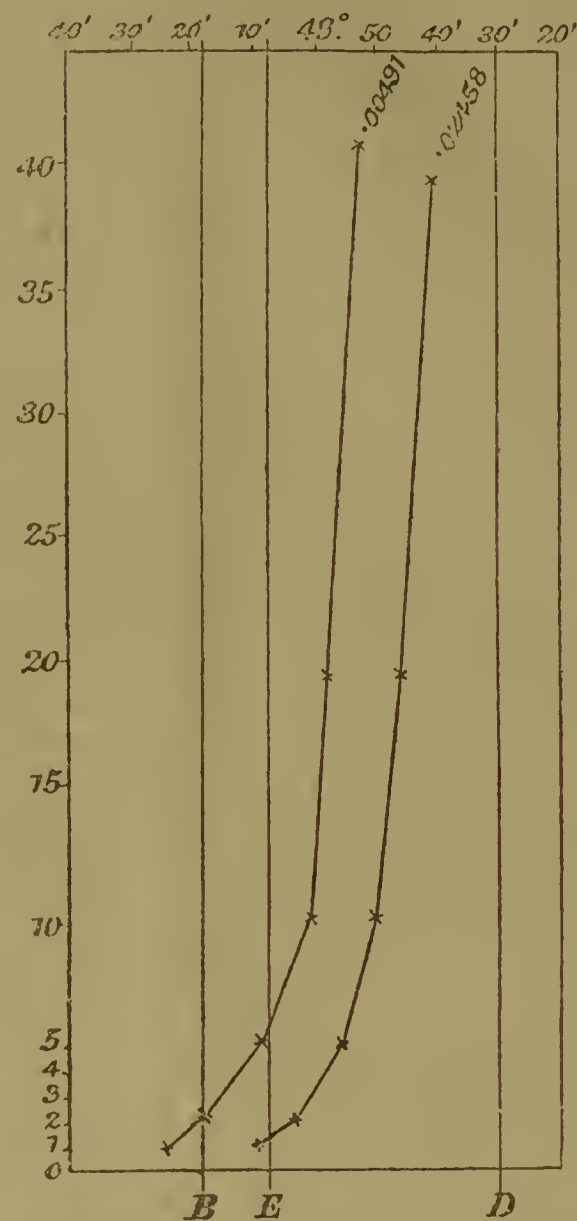
§4. *Size of the Particles Producing Isolated Absorption Bands.*—In §2 we saw how to calculate the stratum-length of a solution of known strength equivalent to a certain thickness of solid. In the present paragraph we have to deal with the converse operation, *i.e.*, the calculation of thickness of solid equal to a certain stratum-length of a solution of known strength. In §2 we used the formula—

$$\frac{tm}{s} = c \quad \dots (1.)$$

Where *t* = thickness of solid plate in m.m.; *m* = weight

in grms. of 1 square centimetre of solid 1 m.m. in thickness; *s* = strength of solution in grms. per c.c.; and *c* = stratum-length of solution of known strength in centimetres.\*

FIG. 2.



The figures at the end of the absorption curves give the strength per c.c. of the aqueous solution employed.

For our present object, therefore,—

$$\frac{cs}{m} = t \quad \dots (2.)$$

We have it in our power now to approximately ascertain the size of the particles whose absorptive influence on light is first evident, for whatever may be the shape of such a molecular aggregate we cannot be far wrong for the present in assuming that its several dimensions are about equal. Hence if we calculate the thickness of solid plate required to give incipient absorption, we have at once the size of the particle which produces the same effect. Such numbers although only roughly approximate are of no small interest, and I therefore give those obtained for several bodies.

	Incipient Absorption.	Width of Molecular Aggregate in m.m.
Permanganate of potash	3 bands	80
Methylaniline violet ..	1 band	63
Magenta .. .. .	1 „	47
Iodine green .. .. .	1 „	480

For greater clearness we may take the observation for permanganate of potash in detail. The mean of two close determinations of its sp. gr. gave 2.349, hence  $m = 0.2349$ . The three principle absorption bands were just visible when 2 centimetres of solution, containing 0.0000095 gm. of the salt per c.c., were introduced between the light source and the spectroscope. Hence—

$$\frac{2 \times 0.0000095}{0.2349} = 0.0000808 \text{ m.m.,}$$

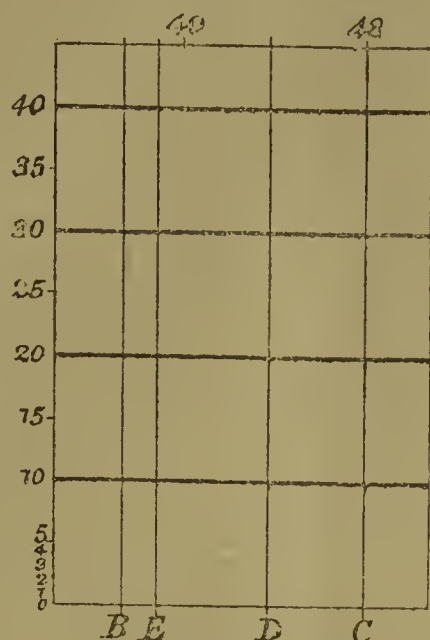
or 80 m.m.

† *c* is really the number of c.c. of solution, but the light being transmitted through each in a straight line we may correctly call it the stratum-length in centimetres.

\* Chem. Soc. Journ., x., 79.

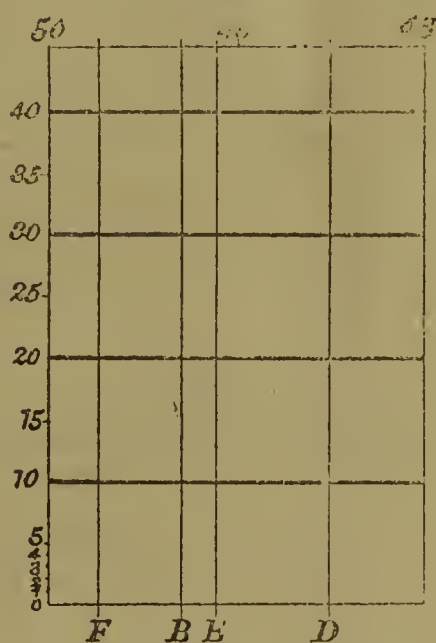
Figs. 3, 4, and 5 are the quantitative absorption spectra of methylaniline violet,  $[C_{20}H_{16}N_3(CH_3)_3]$ , iodine green, and magenta,  $(C_{20}H_{19}N_3, HCl)$ .

FIG. 3.



Aqueous solution of iodine green containing 0.0000147 grm. per c.c.

FIG. 4.



Aqueous solution of magenta, 0.0000008 grm. per c.c.

§5. In comparative experiments on diathermancy, &c., physicists have employed plates of equal thickness. Similar comparisons for the absorption of light have not been hitherto tried, the difficulties in the way being ap-

FIG. 5.

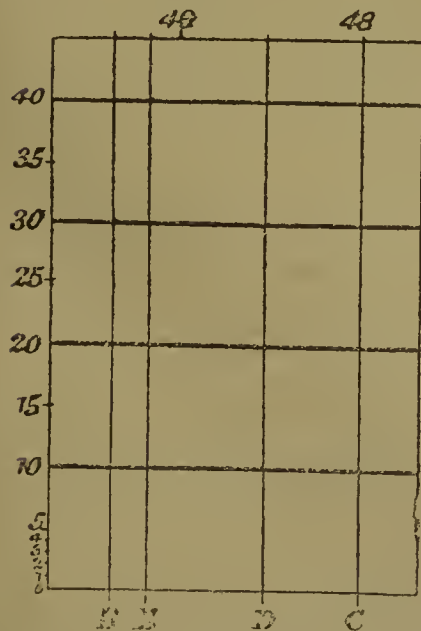


FIG.

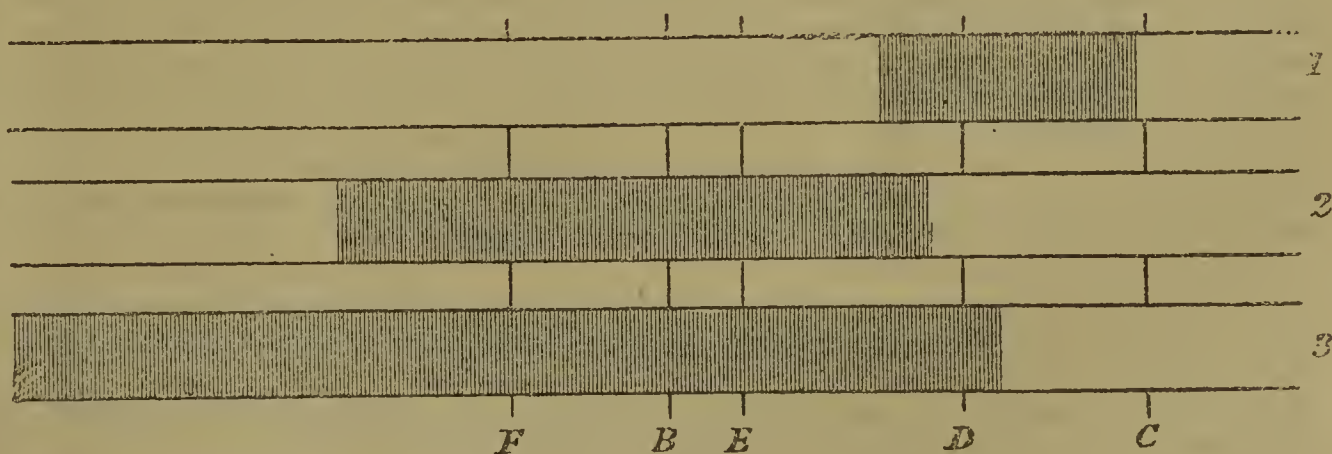


Fig. 5. Methyl-aniline-violet aqueous solution; 0.0000015 grm. per cent.  
Fig. 6. 1, iodine-green; 2, permanganate of potash; 3, magenta.

parently insuperable. It will be evident, however, that this may to some extent be effected by giving for the several bodies experimented with a common value to  $t$  in the formula §4 (1).

Fig. 6 presents such a comparison in which  $t = 0.00288$  m.m. apparently the most convenient thickness for the

comparison. Now in §4 we have given the approximate widths of the molecular aggregate producing absorption, therefore if  $t$  (2880 m.m.) be divided by these figures, we obtain the number of particles in this particular thickness of plate employed; these are—

Iodine green	..	..	..	..	6
Permanganate of potash..	..	..	..	..	36
Magenta	..	..	..	..	61

It is noteworthy that the greater the number of particles in the given thickness, or, in other words, the smaller their size, and the more readily do short-wave radiations seem to be absorbed.

In another paper I propose to apply the foregoing methods to the study of iodine solutions.

## A NEW AND READY METHOD FOR THE ESTIMATION OF NICKEL IN PYRRHOTITES AND MATTES.

By MARGARET S. CHENEY and ELLEN SWALLOW RICHARDS.

We had occasion several months since, to make a number of determinations of nickel in mattes where, for commercial reasons, the element of time was of considerable importance. Our attention was thus called to the various processes which have been recommended for the separation of nickel from iron, and we have submitted these processes to comparative tests, but no one of them seemed perfectly satisfactory for our purpose.

The method most commonly used, perhaps, depends upon the separation of iron as a basic acetate. ("Fresenius," page 363.) This method requires considerable analytical skill and practice in its use. The large dilution and subsequent evaporation necessary render the operation a tedious one, even without the repeated re-precipitations which are indispensable to a complete separation.

The method based upon the behaviour of neutralised solutions at the boiling-point ("Fresenius," page 362), which we personally prefer to use, is open to the same objections. The process of separating the iron by ammonium hydrate, even with all the precautions recommended by various authors, has given very unsatisfactory results in our hands. By far the best success was obtained in the use of the method given by Frederick Field, in the

CHEMICAL NEWS, vol. i, page 5 (1859). The method is as follows:—

"In the case of nickel and iron, the nitrates are evaporated nearly to dryness, and, after the addition of water, oxide of lead (litharge) is added, and the whole boiled for ten minute or a quarter of an hour. The iron

is entirely precipitated, the nitrates of nickel and lead remaining in solution. After filtration, which can be effected with great readiness, dilute sulphuric acid is added, and on standing for sixteen hours the sulphate of lead is filtered off, and the nickel precipitated and estimated in the usual manner."

This process uniformly gave good results as to the separation of iron and nickel, all the nickel being left in solution. The presence of lead in the solution was somewhat undesirable, the results being too high if the nickel was weighed as oxide; and much more caution was required in the battery precipitation. All these methods require two or three days, and the quantity of the ore or matte to be operated upon is limited, usually two to four grms.

Among the numerous tests made for a more ready way were those depending upon the solubility of the sulphates in alcohol and upon the behaviour of the oxalates, but no satisfactory results were reached. Finally a systematic series of tests was made with the phosphates, in the course of which it was found that phosphate of nickel is completely soluble, while phosphate of iron is almost insoluble in acetic acid, in the presence of an excess of phosphate of soda. Upon this fact, which we had not found mentioned in any work that we had consulted, we based the following process.

The ore or matte is dissolved in hydrochloric acid with the addition of a little nitric acid. All the metals of the arsenic and copper groups, if present, are separated by means of hydrogen sulphide with the usual precautions. The filtrate is boiled to drive off the excess of hydrogen sulphide, the iron is oxidised by nitric acid, and ammonium hydrate is added until a permanent precipitate begins to form, but not until complete precipitation is effected. Acetic acid is then added until the precipitated ferric hydrate is re-dissolved and the liquid is of a deep red colour, though not transparent. To this boiling hot solution ordinary phosphate of soda is added in excess, and the nearly white precipitate is filtered and washed with hot water containing acetic acid. The filtrate is heated nearly to boiling, and caustic potash added until the odour of ammonia is distinctly perceptible. The apple-green precipitate of phosphate of nickel is partially washed, dissolved in a little dilute sulphuric acid, the solution rendered strongly alkaline by ammonium hydrate and the nickel precipitated by the battery.

If the ore contains more than 3 per cent of nickel, it is necessary to dissolve the precipitate of phosphate of iron in hydrochloric acid, dilute this solution somewhat, render it nearly neutral by ammonium hydrate, add 25 or 30 cubic centimetres of acetic acid, and re-precipitate by phosphate of soda. The filtrate is added to the first filtrate. If the solution has been rendered alkaline before the addition of acetic acid, or if an insufficient quantity of phosphate of soda has been used, a small amount of iron will remain in the solution, not enough, however, to interfere with the battery precipitation of the nickel. The solution of phosphate of soda should be a saturated one, and, if it is heated separately, the troublesome boiling of the bulky precipitate is avoided. By the aid of the filter pump this precipitate is readily filtered, in spite of its unpromising appearance.

The advantages of this method are: 1st, the concentration of the solution. It may contain 10 to 15 grms. of ferric oxide in a half litre, instead of 1 gm., as in the basic acetate method, and thus larger quantities of a poor ore may be operated on. 2nd. A great saving of time. The nickel may be weighed in eight or ten hours from the time the ore is pulverised and ready for solution. This saving of time is mainly due to two causes. First, less care is required in case of precipitating as phosphate than as basic acetate. Second, in precipitating phosphate of nickel by caustic potash it is not necessary to concentrate the solution nor to expel all the ammonia as is the case in precipitating as hydrated oxide. An unexpected

advantage is the more ready battery precipitation of the nickel from the solution of the phosphate.

Two of the so-called quart carbon cells, each half-filled with the solutions (bichromate of potassium and sulphuric acid) were found quite sufficient to precipitate the nickel completely in two hours. If a strong current was used, the nickel was precipitated in a black, spongy form.

A solution containing 0.375 gm. Ni as chloride, and 1.183 grms. Fe as chloride was made up to 250 c.c.

	Found.	Theory.	Per cent.
100 c.c., of which	0.1486	0.150	99.06
100 c.c. "	0.149	0.150	99.33
50 c.c. "	0.0748	0.075	99.73

To the first portion the phosphate of soda was added first, and the acetic acid afterward.

	Per cent.	
Matte No. 1 gave (phosphate method)	6.77	Cheney.
" " "	6.86	Richards.
" " "	6.48	
Matte No. 2 " (neutralised solution)	2.08	Richards.
" " "	2.37	
" " (phosphate method)	2.15	Cheney.
Matte No. 3 " (phosphate method)	7.22*	Richards.
" " "	7.41†	Hardman.
" " (basic acetate)	7.79	Hardman.
Pyrrhotite No. 1 (basic acetate)	0.32	Hardman.
" " "	0.29	
" " (phosphate method)	0.33	Cheney.
" " "	0.25	
Pyrrhotite No. 2 (phosphate method)	0.725	Richards
" " "	0.686	

—American Journal of Science and Arts.

## REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.‡

By Dr. A. W. HOFMANN.

(Continued from p. 150.)

*Ammonia and Ammoniacal Salts.* By M. SEIDEL, Director of a Manufactory in Amsterdam.

*Applications of Ammonia.*—As already mentioned the consumption of sulphate of ammonia in agriculture has become more and more established. In comparison with guano and with all putrescent manurial matters this salt has the great advantage that all its ammonia is combined, and, although in consequence of this fact the effect is less rapid than that of guano, it is decidedly more permanent.§

The production of caustic ammonia likewise has manifestly increased. Large quantities are required by Carré's ice-machine, which, although still encumbered with a variety of defects is daily finding a more extended application.||

Caustic ammonia is also more and more required in the tinctorial arts, and very recently it has unexpectedly come into use in the preparation of indigo in Java.

\* Mrs. Richards lost a portion of the washings by the breaking of a beaker.

† This was Mr. Hardman's first trial of the phosphate method, and not enough phosphate of soda was added to produce a white precipitate.

‡ "Berichte über die Entwicklung der Chemischen Industrie während des Letzten Jahrzehends."

§ Recently repeated attempts have been made to extract by direct lixiviation the ammonia which accumulates in the composition employed in gas-works for purifying purposes (bog-iron ore and saw-dust) and to utilise it as manure. In consequence, however, of the abundant presence of sulphocyanide in the sulphate, and of its pernicious action upon vegetation, these experiments have led to no favourable result. —(Private communication of Dr. L. Darmstädter to the Editor).

|| Compare the paper by Dr. Meidinger in an earlier portion of this Report.

According to the old process for the preparation of the colour from various species of *Indigofera*, lime was added to the fermenting mass. A Belgian chemist, J. Sayers, of Djocjocarta, in Java, has introduced there a new process. Instead of lime he adds ammonia during the fermentation, and is said in this manner to obtain a purer colour.

The successful resumption of the method tried more than thirty years ago to produce soda by treating chloride of sodium with carbonate of ammonia, has also lately given a considerable impulse to the manufacture of ammonia. Should, as it almost appears, the ammonia-soda process come into use on a larger scale this circumstance would very essentially contribute to a further development of ammonia manufacture.\*

The condensibility of ammonia and its great solubility in water have inspired the idea of using it as a motive power for machinery.

The earliest experiments in this direction are due to Tellier and Flandrin.† In connection with these attempts Tellier has subsequently sought to make ammonia useful in a variety of technological applications, but without arriving at any decided success, which may be partially due to the circumstance that the commercial value of ammonia has so greatly increased of late years. Tellier has collected his suggestions and published them in a separate work — “*L'Ammoniaque dans l'Industrie*.” Paris: J. Rothschild, 1867. Delaporte‡ also has patented an ammonia machine in France.§

We may in conclusion briefly mention a few proposals respecting the preparation of various ammoniacal compounds.

As is well known ammonia is fixed not only by acids but by many salts, which in this case play the part of an acid. These compounds, which have been experimentally examined by H. Rose, Persoz, and Rammelsberg, give off the ammonia when heated, a property which is often used in the laboratory for the preparation of liquefied ammonia. Latterly Knab|| has proposed to obtain such saline compounds of ammonia industrially, and to store up the gas in this form. Such compounds would then only require a gentle heat in order to evolve a current of dry ammoniacal gas. Chloride of calcium can in this manner take up 50 per cent of its weight of ammonia, whilst strong liquid ammonia contains only 20 per cent of dry ammonia. This latter assertion is an error, since water, even at 15°, is capable of taking up more than 30 per cent of its weight of ammoniacal gas.

Ammonium sulphide, so frequently employed for analytical purposes, has been hitherto almost exclusively prepared by passing sulphuretted hydrogen into caustic ammonia. It is now obtained by Spence§ industrially by mixing ammonium sulphate or chloride with twice its weight of alkali-waste or gas-lime, exposing the mixture to the action of steam, and condensing the products of distillation in suitable apparatus.

Kunheim¶ has introduced a simple, but under certain circumstances very advantageous, improvement in the manufacture of ammonium carbonate. Previously this salt had been almost exclusively prepared by the double decomposition of sal-ammoniac and carbonate of lime, the

chloride of calcium, relatively worthless, being obtained as by-product. Kunheim employs instead of carbonate of lime the carbonate of baryta, and obtains a solution of baric chloride, which may be advantageously used in the preparation of permanent white.

*Nitric Acid and its Salts.* By Dr. ADOLPH GEYGER, of Berlin.

Even at the commencement of the present century a part of the saltpetre consumed in the various countries of Europe came from India as so-called exotic saltpetre,\* and the rest of the supply was obtained as native saltpetre by the lixiviation of natural or artificial nitre beds.

The consumption of nitrates in the chemical arts and in the manufacture of gunpowder and of other blasting materials has increased to such an extent that the earlier sources became utterly insufficient. A new supply was laid open in the vast deposit of a mineral very rich in nitrate of soda, discovered more than fifty years ago in the district of Tampa, on the border between Chili and Peru.† The extraction of this deposit is still on the increase and furnishes by far the largest part of the raw material for the nitrates now used in the arts.

According to the statements of Dr. G. Langbein‡ there were in the year 1871 in the Peruvian nitre districts eleven large refineries with a daily production of about 6000 cwts. purified nitrate of soda. The nitriferous mineral, called *caliche*, is found in beds from 0.25 to 1.5 metre in thickness, which, however, rarely rise to the surface. The superincumbent rock, *costra*, is from  $\frac{1}{2}$  to 2 metres in thickness, and consists principally of a hard conglomerate of sand, felspar, phosphates, and other minerals. The composition of the caliche fluctuates; it contains 48 to 75 per cent nitrate of soda, 20 to 40 chloride of sodium, and varying quantities of sulphates of soda and lime, nitrate and iodate of potassa, chloride of magnesium, &c., as also insoluble earthy matters and organic substances (guano). It is first broken up in a disintegrator and placed in the dissolving pans. Some of the establishments use long four-sided cisterns, but the better arranged works use closed egg-shaped boilers provided with two movable covers, of which the upper serves for the introduction of the caliche, and the lower for the removal of the exhausted material. The mass rests upon a perforated false floor fixed at about one-fourth the height of the boiler, and consisting of four pieces movable on hinges. The boilers are filled up to the top with the broken raw material, and up to half height with mother-liquor, and are heated by the direct action of steam, which is admitted by four pipes reaching below the false bottom. In from one and a quarter to two and a half hours the liquid is sufficiently saturated with nitre and is let off into settling tanks; after some hours' rest the clear liquid flows into flat crystallisers fixed in an open place and exposed to the wind. Latterly a second settling-tank has been interpolated, in which the liquid is allowed to remain for about half an hour, in order to deposit the common salt which is held in mechanical suspension before being run into the crystallisers.

The residue left in the boilers, which still contains from 15 to 35 per cent soda saltpetre, is either cleared out at once or extracted once more with spring water. The closed boilers are simply emptied by letting down the lower or true bottom, when the residue falls into waggons run in beneath, and is drawn away from the works. The crystals of nitre which form in the crystallising pans after the mother-liquor is drained away are spread upon a large surface exposed to the wind, and called *cencha*, in layers of from 30 to 50 centimetres in thickness, and dried by being frequently turned over. The total cost of 1 cwt. of Chilean saltpetre up to its conveyance to Europe was calculated in the year 1871 by Langbein, as follows:—

\* According to private communications which the Editor has received from German manufacturers an increase of the demand for carbonate of ammonia, in consequence of its application to the ammonia-soda process, is as yet scarcely perceptible.—(A. W. H.)

† Tellier and Flandrin, *Comptes Rendus*, lx., 59; *Monit. Scientifique*, 1865, 134; *Dingl. Pol. Journ.*, clxxvi., 163; *Deutsch. Industrie Zeitung*, 1865, 126; *Wagner Jahresber.*, 1865, 279.

‡ Delaporte, *Génie Indust.*, August, 1865, 63.

Lamm, of New Orleans, is said (*Engineer*, Jan., 1875) to have constructed an ammonia-machine, which has been successfully tried for street-tramways, the chief difficulty, the loss of ammonia, is almost overcome by the use of an oil joint in the stuffing boxes.

§ Knab, *CHEM. NEWS*, 1866, xiii., 192; *Deutsche Industrie Zeitung*, 1866, 178; *Wagner Jahresber.*, 1866, 205.

|| Spence, *Mech. Mag.*, Nov., 1866, 307; *Dingl. Pol. Journ.*, clxxxiii., 397; *Polyt. Centralb.*, 1867, 461.

¶ Kunheim, *Deutsche Indust. Zeit.*, 1866, 178; *CHEM. NEWS*, 1866 xiii., 192; *Wagner Jahresber.*, 1866, 202.

\* The terms exotic and native saltpetre are not known in the English trade.—*Ed. C.N.*

† Rivere, *Schweigger's Journ.*, xxxiv., 450

Langbein, *Wagner's Jahresber.*, 1871, 300, and 1872, 290.

Cost of production .. ..	3.25 marks
Conveyance to the coast .. ..	2.40 „
Cost of shipping.. ..	0.25 „
Freight to Europe .. ..	2.75 „
Charges on arrival .. ..	0.25 „
	<hr/>
	8.90 „

or about 8s. 8d.

W. Lloyd,\* in 1868, calculated the cost of production at 8.40 marks per cwt. The rise of price in spite of the improvements in the process of purification, is due to the enormous increase in the cost of labour and in the freight to the Port Iquique. Although the saltpetre districts have been now for some years connected with the port by a railway, the greatest part of the produce is still conveyed upon mules.

The exportation of nitre is still constantly on the increase, as the following figures prove:—

1830 .. .. .	18,700 cwts.
1835 .. .. .	140,399 „
1840 .. .. .	227,362 „
1850 .. .. .	511,845 „
1860 .. .. .	1,370,248 „
1870 .. .. .	2,943,413 „
1871 .. .. .	3,605,906 „
1872 .. .. .	Upwards of 4 million cwts.

By the decree of July 12th, 1873, the Peruvian Government has taken the saltpetre trade into its own hands, and has fixed the quantity that may be yearly exported at  $4\frac{1}{2}$  million cwts. As to the effect of this monopoly upon the saltpetre trade, no decision can as yet be formed.

As a specimen of the composition of the purified soda saltpetre, as imported into Europe, the following very complete analysis, published by Wagner,† may be cited:—

Sodium nitrate .. .. .	94.03
„ nitrite .. .. .	0.31
„ chloride .. .. .	1.52
„ sulphate .. .. .	0.92
„ iodate .. .. .	0.29
Potassium chloride .. .. .	0.64
Magnesium chloride .. .. .	0.93
Boracic acid .. .. .	trace
Moisture .. .. .	1.36

100.00

The mother-liquor of the refineries contains from  $2\frac{1}{2}$  to 5 grms. iodine per litre, and is used in some Peruvian establishments as a source of that body. (Compare chapter on Chlorine, Bromine, and Iodine.)

As to the origin of these saltpetre beds in Peru various explorers have published their opinions, but without giving a fully satisfactory explanation. Indeed it would almost seem as if the formation had taken place under circumstances which have remained hitherto unknown. According to H. Reck‡ Chili saltpetre is the oxidation product of large guano beds, whereby, however, as Nöllner very justly remarks, it remains unexplained what can have come of the great mass of sparingly soluble phosphate of lime, whilst the readily soluble nitrate of soda remains behind.||

(To be continued.)

The Commission of the Academy of Sciences and the Experiments of MM. Pasteur and Bastian.—This commission has proved a failure, and has never even witnessed the experiments of Dr. Bastian. With whom the blame must rest it would be premature to decide.—*Moniteur Scientifique*.

\* Lloyd, *Wagner's Jahresber.*, 1869, 247.

† R. Wagner, *Wagner's Jahresber.*, 1869, 248.

‡ H. Reck, *Berg. u. Hutten. Zeit.*, 1863, 188, 207, 225, 229; Wagner, *Wagner's Jahresber.*, 1863, 303.

|| Without wishing to advocate the guano theory, we may point out that the *costra*, or superincumbent rock, has just been described as consisting in part of phosphates.—ED. CHEM. NEWS.

## NOTICES OF BOOKS.

*Report on Public Health.* By CHARLES A. CAMERON, M.D. Dublin: Printed for the Author.

THIS pamphlet comprises a number of distinct essays on subjects connected with public health. The first of these essays is devoted to the consideration of the use of stimulants in public institutions, the latter term being here used to signify workhouse-hospitals. Several interesting cases of the adulteration of alcoholic beverages are given. Thus, a sample of port examined by the author, for the Guardians of Kilrush Union, contained, per pint, 886.8 grains of sugar, chiefly cane. The so-called Hambro' sherry, largely used in Ireland, and still more in England and Scotland, is made up of "silent spirit," sugar, and a small proportion of genuine wine. He recommends, instead of sherry, marsala; and instead of port, Carlowitz, as being more easily obtained in a state of purity.

*A Plan for rendering Salted Meat more Nutritious, thereby preventing Scurvy.* By R. GALLOWAY, F.C.S. Dublin: Hodges, Foster, and Co. London: Simpkin and Marshall.

THE author recommends that phosphate of potash should be added to salt meat, with a view of supplying principles in which it is deficient, as the proportion naturally present is almost entirely eliminated in the process of salting. Strangely enough, this very simple, and by no means disagreeable, prophylactic cannot secure a trial either in the Royal Navy or in merchant ships, though medical men admit that it could not prove injurious in any case, even should it prove ineffectual. We meet with the curious and novel piece of information that lime-juice, the favourite safeguard against scurvy, acts in many cases as an anaphrodisiac, and that its use is avoided by sailors and others on that account whenever possible. Is this property common to all the vegetable acids?

## CORRESPONDENCE.

### DAVYUM.

*To the Editor of the Chemical News.*

SIR,—I beg to correct the table of the solubility of the sodium-davyum chloride compound mentioned in my second communication on the metal davyum (*CHEMICAL NEWS*, vol. xxxvi., p. 114), as follows:—

Temperature. C.	In 100 parts of—	
	Alcohol.	Water.
0.0°	0.05	0.09
20.0	0.08	0.11
40.0	0.10	0.14
70.0	0.07	0.10
78.3	0.06	—
100.0	—	0.08

—I am, &c.,

SERGIUS KERN, M.E.

## REVERSAL OF THE SODIUM LINES.

*To the Editor of the Chemical News.*

SIR.—Lately my attention has been called to this phenomenon as occurring in a manufacturing operation, by my friend Mr. T. E. Hoyle, of Blackley. In the making of nitrite of soda, as your readers are aware, small coal and carbon are thrown on to the fused nitrate of soda, and instantly there is a blaze up from the combustion of these materials. Now, if the spectroscope be directed to this

source of light for the few moments it lasts, the D lines are observed to be beautifully reversed, and I do not remember to have seen the phenomena so well produced before.

The various conditions under which *reversion* may be produced cannot fail to interest chemists as well as physicists; and the former who have facilities for observations of this kind, in the manufacture of salts of the alkaline earths, especially nitrites under the conditions stated above, would add to our limited stock of knowledge by reporting the facts they learn.—I am, &c.,

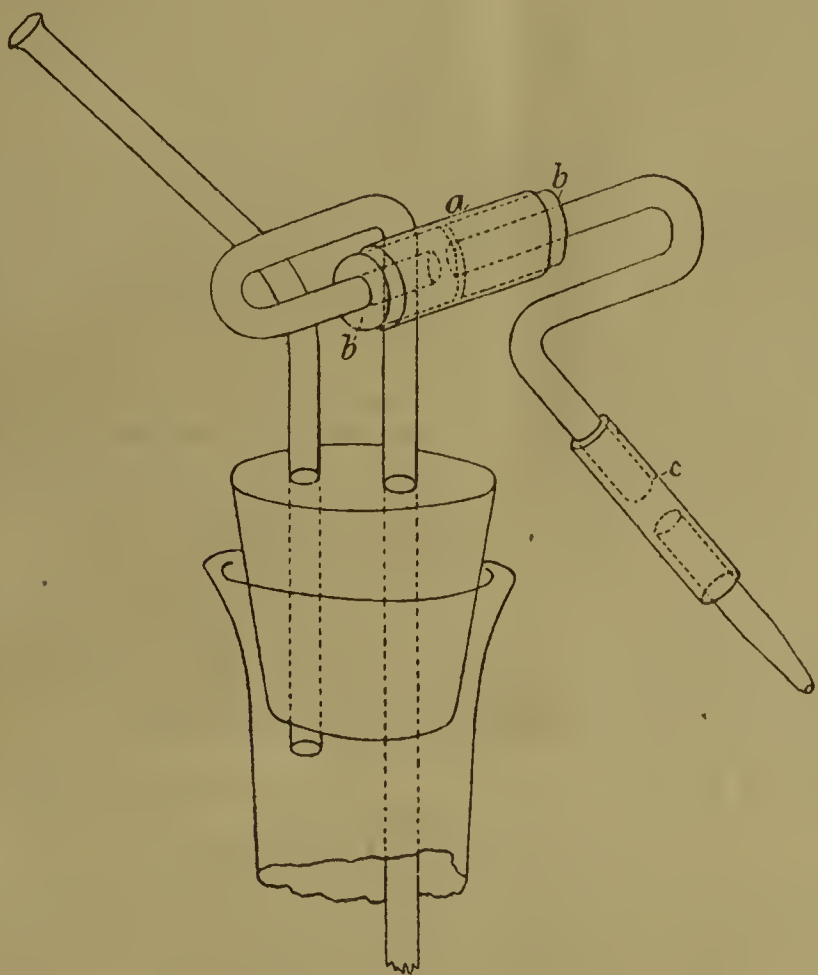
WM. ACKROYD.

Science Schools, South Kensington,  
October 1, 1877.

## USEFUL JET FOR A WASH-BOTTLE.

To the Editor of the Chemical News.

SIR,—A more universally useful jet for a wash-bottle than the one figured in the CHEMICAL NEWS (vol. xxxvi., p. 119) is in general use in Prof. Bunsen's laboratory at Heidelberg (also figured in Prof. Thorpe's "Quantitative Analy-



sis"). *a* represents a piece of stout glass tube; *bb* are two corks; and *c* a piece of india-rubber tube, and one finger suffices to guide the jet in all directions. The arrangement does not get out of order.—I am, &c.,

CHAS. O. TRECHMANN, Ph.D.

Hartlepool, September 15, 1877.

## JOURNAL OF THE CHEMICAL SOCIETY.

To the Editor of the Chemical News.

SIR,—On page 373 of the newly-issued number of the *Journal of the Chemical Society* I notice an abstract of a foreign paper on "Differences observed in Unadulterated Milk." The author (E. Reichardt) observes that "the specific gravity of cow's milk varies from 1.018 to 1.045, but is generally 1.040." Some important analyses follow, in which no mention is made of the existence of "ash," though the results "add up" to 100.

At a recent meeting of the Chemical Society, at which the subject of the *Journal* and its contents was pretty

freely discussed, attention was drawn to the utterly useless and scientifically worthless paragraphs which are occasionally allowed to figure in a permanent place of honour in its pages, notwithstanding the pressure of valuable "over matter" remaining on the printer's table month after month. The above is a forcible case in point. What is the use of retailing to the readers of the *Journal of the Chemical Society* such utter nonsense as that enunciated in the first sentence of the paragraph from which I have quoted? It appears to me that from the publication of such abstracts three consequences follow:—First of all, there is a decided waste of space—in this case about half a column; secondly, there is the possibility of dangerously misleading a tyro, who might, not unnaturally, be inclined to attach weight to statements of such a nature, abstracted without comment in a publication of such high authority; thirdly, there is the effect of bringing down some well-merited ridicule upon the original author of the paper. If these consequences justify the appearance of such an abstract, by all means let it appear; but the propagation of notoriously erroneous facts by such a medium as a standing English record of chemical science seems to me, for many reasons, most undesirable.—I am, &c.,

ANALYST.

London, October 1, 1877.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 12, Sept. 17, 1877.

New Researches on the Ammoniacal Fermentation of Urine, and on Spontaneous Generation.—P. Caze-neuve and C. Livon.—The experiments of the authors confirm the views of M. Pasteur, and lend no countenance to the hypothesis of generation not due to pre-existing germs.

*Moniteur Scientifique Quesneville.*  
September, 1877.

Constitution of Ultramarine.—J. Philipp.—Taken from Liebig's *Annalen*, clxxxiv., p. 132.

Chemical Equivalents and Atomic Weights as Bases of a System of Notation.—M. C. Marignac.

Observations on Chemical Equivalents as Compared with Corpuscular Elements.—A. Baudrimont.—These two papers are contributions to the recent controversy between M. Berthelot and M. Würtz.

Reports of Foreign Researches.—M. F. Reverdin.—These consist exclusively of papers extracted from the *Berichte der Deutschen Chemischen Gesellschaft* and noticed elsewhere.

Analysis of Butter as regards the Detection of Foreign Fats.—M. Otto Hehner.—The contents of this paper may be found on reference to the author's English work on the same subject.

On Carbuncle and Septicæmia.—MM. Pasteur and Joubert.—Taken from the *Comptes Rendus*.

Etiology of Carbuncular Disease.—M. Colin.—A pathological paper.

Note on Dr. Bastian's Experiments on Urine Neutralised with Potassa.—M. Pasteur.—Taken from the *Comptes Rendus*.

Sources of Carbonic Oxide.—M. Lorin.—Unsuitable for abstraction.

**Magnetism of Nickel and Cobalt.**—M. Hankel.—With feeble currents the magnetic power of nickel is equal to that of soft iron, but with stronger currents it is comparatively feeble. The magnetic power of cobalt under any circumstances is much lower than that of the two other metals.

**Novel Colouring Matters.**—MM. E. Willm, G. Bouchardat, and Ch. Girard.—This paper will be inserted in full.

**French Association for the Advancement of Science.**—An announcement of the proceedings of the Association.

**The Iodide of Starch: The Theory of its Decolouration by Heat and of its Recolouration on Cooling.**—M. H. Pellet.—Reserved for insertion in full.

**Plastered Wines.**—M. Marty.—In a ministerial circular it is decreed that no wine shall be received in the military hospitals if it contains more than 2 grms. sulphate of potassa per litre. The author accordingly gives a process for determining if this limit is exceeded. (Why "plastering" should be tolerated at all might prove a very difficult question to answer.)

**Detection of Resin in Soaps.**—M. C. Barfoed.—The author decomposed the soap with hydrochloric acid and washes the mass thus obtained with water. He then treats it with a lye of caustic soda of sp. gr. 1.10, diluted with six volumes of water, avoiding excess. He then evaporates to dryness in the water-bath, grinds up the residue, and dries in the stove at 100°. One portion of this powder is utilised for the determination of the fatty acids. Another portion is put in a very dry bottle, and 5 to 10 c.c. of absolute alcohol are added for every grm. of soap. It is heated to 80° to dissolve the soaps of the fatty acids and of resin, and allowed to cool again, well stoppered. The alcoholic liquid when cold is mixed with five times its volume of ether, the whole is well shaken up and left to settle. The resin soap is entirely dissolved, whilst the soap of the fatty acids is deposited almost entirely. After standing for 24 or 48 hours the ethereal liquid is decanted, evaporated, and the residue is treated with hydrochloric acid. This method is based upon the slight solubility of a soda-soap of the fatty acids in the above-mentioned mixture of alcohol and ether.—*Zeitschrift f. Analyt. Chemie*, xiv., 20.

**Detection of Free Hydrochloric Acid in Admixture with Chlorides.**—M. Loewenthal.—If red lead is added to the solution of a chloride containing free hydrochloric acid, this oxide is decolourised and chlorine is given off. The reaction does not succeed in presence of ferric and stannic chlorides, but it gives a good result along with the chloride of aluminium.—*Zeitschrift f. Analyt. Chemie*.

**Detection of Traces of Iron in Salts of Nickel.**—M. Boettger.—A solution of nickel is poured into a test-tube, acidulated slightly, and a few drops of sulphocyanide of potassium are added. On agitating the mixture with a few c.c. of ether, we obtain a rose-coloured ethereal stratum if the smallest quantity of iron is present. To remove all iron, the aqueous solution of the nickel salt is boiled for ten minutes with protocarbonate of nickel, or, in default of this salt, a few drops of carbonate of soda are added. Finally the whole is filtered, when the iron remains upon the filter with the excess of nickel carbonate.—*Neues Repert. f. Pharmacie*, 1875, p. 621.

**Preparation of Thallium.**—M. J. Krause.—Three casks are set one above the other, so that the contents may be drawn from one to another by means of a syphon. In the upper cask the flue-dust is exhausted with water heated by a jet of steam. The clear concentrated liquid is run into the second cask, where the thallium is precipitated by hydrochloric acid. The washing liquors are reserved for a new operation. The precipitation of the chloride of thallium is rendered more complete by briskly agitating the solution. When the liquid is drawn off, the second cask is filled with pure water mixed with a suf-

ficient quantity of sulphate of soda to give it the same degree of concentration as before. The agitation of the mixture determines a slow decomposition, and the liquid flows off into the lower cask, where it is acidulated with sulphuric acid, and the thallium is precipitated with plates of zinc. The spongy thallium is well washed, strongly compressed, and melted in a crucible. The author has obtained 10½ kilos by this method.—*Dingler's Polytech. Journal*, ccxvii.

*Les Mondes, Revue Hebdomadaire des Sciences*,  
Sept. 13, 1877.

At the the forthcoming Paris Exhibition there will be distributed 1000 gold medals, 4000 medals of silver, 8000 of bronze, and 8000 honourable mentions, besides 100 grand prizes and exceptional rewards in silver.

Zinc powder, which is now an article of commerce, and is used in the tinctorial arts and in certain chemical manufactures, is composed as follows:—Zinc, 40; lead, 2.5; cadmium, 4; zinc oxide, 50; zinc carbonate, 3.5; total, 100.0; non-metallic dust, traces. If moistened it becomes spontaneously inflammable, and according to *Dingler's Journal* has occasioned conflagrations on board ship.

*Bulletin de la Société d'Encouragement pour l'Industrie Nationale*.

No. 45, September, 1877.

Report by M. S. Cloëz, on behalf of the Committee of the Chemical Arts on M. Sourdat's "Draining Turbine" for Laboratory Use.—The apparatus in question is a kind of hydro-extractor, the precise arrangement of which is scarcely intelligible without the aid of illustrations.

**Studies on Nitro-glycerin and Dynamite.**—A. Brull.—These compounds are here considered from the point of view not of the chemist, but of the engineer.

## TO CORRESPONDENTS.

*James Mulvey.*—The salt used by indigo dyers is not the hyposulphite but the hydrosulphite of soda. Hyposulphite is, however, used to some extent as a mordant in dyeing, and as an "antichlore" in bleaching.

*G. Lamy.*—We know of no special work on the subject.

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beg to announce that they have been instructed to SELL BY AUCTION, on Tuesday and Wednesday, October 16th and 17th, 1877, commencing each day at 11 for 12 o'clock punctually, the whole of the extremely valuable PLANT and MACHINERY, including two horizontal high pressure steam engines, about eight horse-power, with boilers and connections; double action pumping engine, with boiler and connections; donkey engine, Hind's patent cart weighing machine, by Kitchin, Warrington; smaller ditto, by Pooley and Sons; large lead chambers, tanks, cisterns, rolls of new lead, &c., containing about 100 tons of sheet lead and piping; soda-ash mill, with French stones and connections; mortar mill, finishing furnaces, salting down pans, burners, black-ash furnaces, condensers, iron pillars, large quantity of fire-bricks; contents of smiths' and carpenters' shops; wrought- and cast-iron tanks, crab winch, tank plates, copper boiler, iron wheel barrows and bogeys, quantity of caustic soda drums, timber in the round, planks, boards, and scantling, wrought- and cast-iron, and other miscellaneous effects.

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# THE CHEMICAL NEWS.

VOL. XXXVI. No. 933.

## NOTES OF WORK BY STUDENTS OF PRACTICAL CHEMISTRY IN THE LABORATORY OF THE UNIVERSITY OF VIRGINIA. No. VI.

Communicated by J. W. MALLET,  
Professor of General and Applied Chemistry in the University.

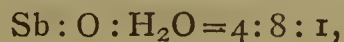
(Concluded from p 158.)

### (4.) Analysis of Native Antimony Ochre from Sevier Co., Arkansas. By J. R. SANTOS, of Guayaquil, Ecuador.

This mineral accompanies stibnite in a vein of the latter of workable dimensions. Specimens of it were sent me by a former student, Mr. C. E. Wait. The ochre occurs in pieces of considerable size, sometimes several pounds in weight, of coarsely fibrous or bladed structure, like that of the sulphide from whose alteration it has doubtless been produced, of straw-yellow colour, in parts tinted brown by iron. The hardness is a little over 4. The sp. gr. = 5.58. After drying the mineral at 100° C., water was driven off by heating in a stream of carbon dioxide, and collected in a chloride of calcium tube. The remaining oxide was very gently heated, and hydrogen passed over it, the water formed being collected as before. The residue in the tube was pure metallic antimony, with the exception of a little siliceous residue left on solution in acid. The analysis gave—

Sb (by difference) .. .. .	76.15
O .. .. .	19.85
H <sub>2</sub> O .. .. .	3.08
Insoluble siliceous matter .. ..	0.92
	<hr/>
	100.00

These numbers represent pretty nearly the ratio—



giving the formula  $2\text{Sb}_2\text{O}_4 \cdot \text{H}_2\text{O}$ ; or if the true hydrate, as artificially produced, be  $\text{Sb}_2\text{O}_4 \cdot \text{H}_2\text{O}$ , this ochre may very possibly be a mixture of Cervantite (anhydrous  $\text{Sb}_2\text{O}_4$ ) and stibiconite ( $\text{Sb}_2\text{O}_4 \cdot \text{H}_2\text{O}$ ).

### (5.) Examination of an Unusual Form of Stibnite from Oregon. By J. R. SANTOS.

Amongst some minerals from the Cabell Mine, in Elk Creek district, Grant Co., Oregon, was a specimen labelled "Jamesonite, with pyrargyrite." The red silver ore was in small quantity, but easily identified; the chief portion of the mass, beside a quartz gangue, consisted of little globular masses, from a quarter to half an inch in diameter, more or less compacted together, and often presenting a thin shell of quartz on the exterior, with crystalline outside surface. The nodules on being broken across showed a fine fibrous structure, the fibres radiating on all sides from the centre: the colour was dark bluish grey, with metallic lustre; the general appearance much like that of some specimens of Jamesonite and Zinkenite. It was supposed to be one of these species, or possibly new, and was handed over to Mr. Santos for analysis, but on examination it proved to be simply stibnite—the ordinary sulphide of antimony. The specific gravity, too, was found to be that of the common mineral.

### (6.) Analysis of Auriferous Cobalt Ore from Grant Co., Oregon. By ST. GEORGE T. BRYAN, of Fluvanna Co., Virginia.

In the same lot of Oregon minerals (for which I was indebted to Mr. F. E. Cabell of that State) in which the above stibnite was found there were some specimens illustrating an uncommon association of gold, namely, an auriferous ore of cobalt from Dixie Creek, Grant Co. Through a quartose gangue the ore was distributed in little strings and grains of greyish white colour and metallic lustre.  $H=5$ ; sp. gr. = 5.36. It was associated with some little visible particles of copper pyrites, and more or less crusted over with an earthy product of oxidation, partly white, in parts coloured pink by cobalt. Breaking up several of the larger pieces, the purest grains of the ore which could be seen were picked out for analysis, but, as the results show, the separation was by no means complete. Mr. Bryan's analysis yielded—

S .. .. .	3.23
As .. .. .	49.19
Bi .. .. .	1.31
Co .. .. .	11.19
Ni .. .. .	3.79
Fe .. .. .	12.82
Cu .. .. .	2.44
Au .. .. .	trace
As <sub>2</sub> O <sub>5</sub> .. .. .	2.30
Cl .. .. .	trace
CoO .. .. .	trace
MgO .. .. .	0.94
Na <sub>2</sub> O .. .. .	0.30
K <sub>2</sub> O .. .. .	0.40
SiO <sub>2</sub> .. .. .	9.71
H <sub>2</sub> O .. .. .	1.52
	<hr/>
	99.14

These numbers agree well with the proximate composition—

Smalltite (ferriferous) .. .. .	76.88
Chalcopyrite .. .. .	7.09
Arsenates (Hörnesite, erythrite, &c.)	5.46
Quartz .. .. .	9.71
Gold .. .. .	trace
	<hr/>
	99.14

In the smalltite the atomic ratio—

$$\left\{ \begin{array}{l} \text{Co} \\ \text{Ni} \\ \text{Fe} \end{array} \right\} : \left\{ \begin{array}{l} \text{As} \\ \text{Bi} \\ \text{S} \end{array} \right\} = 4450 : 6856,$$

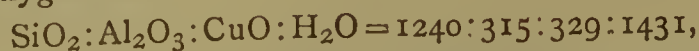
or nearly  $\text{R}_2''\text{As}_3$ . The occurrence of alkaline arseniates, even though in very small quantity, along with the corresponding salts of magnesium and cobalt, is interesting; the former were in part dissolved out by water, and separately identified. Assay upon the large scale had shown that the gold was present to the extent of about 6 ounces per ton of ore.

### (7.) Analysis of Aluminous Chrysocolla from Utah. By J. R. SANTOS.

Amongst some copper ores obtained from the Baltimore Copper-smelting Works there were several specimens of chrysocolla from Utah, partly earthy and partly vitreous in appearance. Some fragments of the latter variety, apparently very uniform and free from any admixture, were selected for analysis. The mineral was light greenish blue in colour, with a pale blue streak, sub-translucent.  $H$  = not much over 2. An attempt of Mr. Santos to take the specific gravity was foiled by the large absorption of liquid by the mineral, of which no pure fragment could be found large enough to be readily protected by varnish. On analysis the following results were obtained:—

SiO <sub>2</sub>	..	..	..	..	..	37.19
Al <sub>2</sub> O <sub>3</sub>	..	..	..	..	..	10.78
CuO	..	..	..	..	..	26.03
H <sub>2</sub> O	..	..	..	..	..	25.76
						99.76

The oxygen ratio—



Hence we have the normal meta-silicate formula for chrysocola,  $\text{CuSiO}_3 \cdot 2\text{H}_2\text{O}$ , with some water in excess, and with one-half the copper replaced by an equivalent amount of aluminum. Although several analyses on record include aluminum as a constituent, I know of none containing half as much as appears in this case; the next largest proportion which I find being 4.97 per cent in a specimen from Coquimbo in Chili, analysed by Field (*Phil. Mag.*, [iv.], xxii., 361).

University of Virginia,  
August 31, 1877.

#### NOTE ON THE ACTION OF SILVERED ZINC-FOIL ON AMMONIUM FORMATE, &c.

AMMONIUM formate ( $\text{HCOONH}_4$ ) solution is decomposed by zinc, especially in presence of copper or silver. With silvered zinc the action begins and continues at the ordinary temperature; on warming, the evolution of gas (hydrogen and ammonia) is very strong. The formic molecule is not affected, the action being a simple replacement of  $2\text{NH}_3$  by Zn.



*Experiment.*—An excess of silvered zinc-foil was permitted to work exhaustively on strong ammonium acetate solution. Some of the clear solution being evaporated (spontaneously), yielded brilliant, transparent, cubical crystals, not deliquescent in the air, and insoluble in alcohol, and yielding ZnO on ignition.  $\text{CH}_3\text{COONH}_4$  is decomposed in an analogous manner by silvered zinc, ammonia, hydrogen, and zinc acetate being formed. The action is not so energetic as with the formate.

W. R. H.

Würzburg.

#### AN ANCIENT SPECIMEN OF TIN.

By Prof. A. H. CHURCH.

TOWARDS the close of the year 1875 a mummy, which had been recently brought from Egypt by Lord Eustace Cecil, was unrolled under the superintendence of Mr. R. H. Soden-Smith, of the South Kensington Museum. Beyond a strip of white metal nothing was found within the cloths of the embalmed body. This strip of metal was embedded in pitch resting on the breast in contact with the flesh—the usual position of the Scarabæus emblem. It was destitute of all ornament or engraving, but presented the outline of the winged Scarabæus, in the form of which it would have been fashioned had the mummy been of the first class, such a Scarabæus being an emblem of immortality among the Egyptians. The date of this mummy must be placed not later than 600 or 700 B.C. It became of interest to ascertain the nature of the metal of which the small plate was composed. On making a qualitative testing of a small fragment it proved to be pure tin, neither lead nor silver being detected. As sufficient material for a complete analysis could not be appropriated, an exact determination of the specific gravity of the specimen was made. The figure thus obtained was 7.369 at 16° C., a number very near that of pure tin, namely 7.29 to 7.373.

In the British Museum, the Louvre, and the Egyptian Museum at Turin, there are several small oblong and

square plates of metal which have been likewise found in unrolling Egyptian mummies. Where labelled they are generally described as "silver," "lead," "white metal," or "mixed metal," and in most cases appear to contain, if not to consist of, lead. That the ancient Egyptians were familiar with some of the uses of tin—as in enamels and bronzes—has long been known; that they were acquainted with tin in a state of chemical purity would now seem to be established.

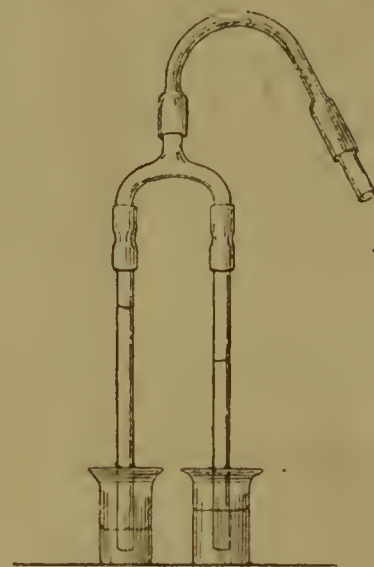
The strip of tin weighed 4.031 grms., and was about 0.3 millimetre thick, 93 m.m. in length, and 18 m.m. in breadth.

#### ON A SIMPLE SPECIFIC GRAVITY APPARATUS FOR LIQUIDS.

By JAMES TAYLOR.

It is often desirable to ascertain approximately the specific gravity of a liquid in cases where the hydrometer and specific gravity bottle are not applicable, or would take up too much time. The following contrivance answers very well for this purpose, is very readily applied, even with tolerably small quantities of liquid, and easily gives results correct to the first decimal place.

Two straight pieces of glass tubing, 5 to 10 m.m. bore and 250 m.m. long, are joined by caoutchouc tubing to two ends of a T-joint which have been bent so as to be parallel. The third end of the T-joint has a piece of



caoutchouc tubing of convenient length slipped on, and this is stoppered by means of a bit of glass rod. Two small beakers, a rule, and any convenient stand arranged so as to hold the long tubes vertically, complete the apparatus.

Its application is almost obvious. On pouring a little distilled water into one beaker, and the liquid whose specific gravity is to be determined into the other, bringing the beakers under the two vertical tubes so as to immerse the ends of the latter in the respective liquids, and partially exhausting above, the liquids will rise to heights depending on their relative densities. The plug is now inserted, the lengths of the liquid columns are measured, and the specific gravity required is obtained by dividing the length of the water-column by that of the other.

Metallurgical Laboratory, Owens College,  
September 29, 1877.

**Novel Method of Preparing Oxygen.**—Sylvester Zinno.—The author finds that oxygen may be very readily obtained even at common temperatures by the mutual reaction of two oxygenated compounds formed of several atoms of oxygen, *i.e.*, hypochlorate of lime and peroxide of barium. These facts prove, he considers, that the oxygen is produced by the neutralisation of the opposite electric polarities of the oxygen in one of the compounds and that in the other.—*Les Mondes*.

REPORT  
ON THE  
DEVELOPMENT OF THE CHEMICAL ARTS  
DURING THE LAST TEN YEARS.\*

By Dr. A. W. HOFMANN.  
(Continued from p. 164.)

*Nitric Acid and its Salts.* By Dr. ADOLPH GEYGER, of Berlin.

THE hypothesis of C. Nöllner† possesses the greatest amount of probability. He believes that in consequence of storms prodigious masses of seaweed, all nitrogenous, have been driven into that bay of South America, and have given rise to nitrate of soda by a process of slow oxidation.

In support of his view Nöllner adduces the constant occurrence of iodine in the nitrates, and concludes, therefore, that their origin can be due only to seaweeds, those nitrogenous collectors of oceanic iodine. The geographical position of the saltpetre beds agrees, in fact, very well with this theory, since on this coast west winds blowing from the sea predominate, their action being supported by the currents flowing along the coast. If these westerly winds only a few times in the course of centuries became violent hurricanes, and threw colossal masses of seaweeds collected from the enormous surface of the Pacific upon the land, which is entirely rainless, and consists of a parched-up plain or of a hilly alluvium, a zone of seaweeds would be formed exactly as represented by the nitre-beds of Peru. We should, of course, have to assume that the nitre when formed was withdrawn from the action of the waves by volcanic elevation or by the retrocession of the sea. The small percentage of potassium in Chilean nitre corresponds with the proportion of potash in the seaweeds, and the constant occurrence of boro-sodio-calcite reminds us of the boriferous minerals in rock-salt and in deposits of potassium chloride.

*Nitrate of Potash.*—For the manufacture of gunpowder nitrate of soda is not adapted on account of its hygroscopic nature. For this purpose it must be transformed into potash saltpetre. Hence large establishments have latterly sprung up for the manufacture of what is called, in contradistinction to the natural article, “converted saltpetre.”

The industrial preparation of this converted nitre seems to have been undertaken almost simultaneously by Wöllner,‡ Grüneberg,§ and Nöllner|| about 1855, when a considerable demand for saltpetre suddenly sprung up in consequence of the Crimean war. Up to that date India and the native nitre-beds had supplied all that was required by the powder works. The importation of Indian saltpetre has latterly declined, and the manufacture of native saltpetre has come entirely to an end in England, France, and Germany, and is only now carried on upon a small scale in Sweden, Russia, and Spain.

The method now almost exclusively adopted for the production of converted saltpetre depends on the double decomposition of nitrate of soda and chloride of potassium, so as to yield nitrate of potash and chloride of sodium. Since the discovery and working of the deposits of potassium salts at Stassfurt the chloride of potassium is not merely the cheapest source of potash, but admits of the most complete decomposition.

As early as 1858 Anthon¶ published a practical process

for the manufacture of potash saltpetre from Chilean nitre and potassium chloride. In 1859 Kuhlmann\* reconsidered this method of manufacture, with especial regard to French requirements, and Waltl† proposed to use the mother-liquor of brine-springs or of sea-water, containing chloride of potassium, in the preparation of saltpetre.

A full description of the method of manufacturing converted saltpetre, as used in England in 1866, has been published by Lunge.‡ Equivalent weights of Chili nitre and Stassfurt potassium chloride—whose composition has previously been determined by analysis—are dissolved in water in large iron pans, and heated to a boil by the direct introduction of steam. The lye after settling is allowed to cool whilst constantly stirred, when the potash saltpetre is deposited as a fine crystalline meal, which is placed in wooden troughs lined with lead, and washed with water till a sample on being tested with chloride of silver contains only  $\frac{1}{100}$  per cent chloride of sodium. When the washing is completed the still adherent mother-liquor is removed by means of centrifugals, and the saltpetre is then dried upon wooden surfaces in heated rooms. The mother-liquors are concentrated over an open fire, when the bulk of the common salt is deposited and “fished out,” whilst the liquid on cooling yields a further quantity of pulverulent saltpetre. In another establishment a solution of potassium chloride is first prepared of specific gravity 1.200 to 1.210: in this the equivalent weight of Chili saltpetre is dissolved, and the solution is then concentrated over an open fire. The common salt which continually separates out is withdrawn, drained, and washed with water as long as it retains  $\frac{1}{2}$  per cent saltpetre, the washings being returned to the pan. When the lye is concentrated to specific gravity 1.500 it is allowed to settle for a short time, when the common salt, as deposited, carries with it all dirt, and the clear solution is run into the crystallisers. By means of occasional agitation the crystals are obtained as fine as those of Epsom salt: the mother-liquor is drawn off, and the crystals allowed to drain perfectly. They are then covered with cold water; after seven to eight hours the liquid is again drawn off, and after the crystals have drained for twelve hours more water is poured on. This washing process is repeated till the desired purity is reached, which is generally the case after the second washing.

The author saw, in 1869, in a Scotch manufactory, this method so modified that the dry salts, chloride of potassium, and Chili saltpetre, in equivalent proportions, were mixed and heated with a quantity of mother-liquor insufficient for complete solution. The operation was carried on in a number of iron cylinders, not very large, fitted with mechanical agitators, and heated with steam-jackets. The abundant aqueous vapours evolved were conducted through a lateral flue into the chimney of the works. After agitation for several hours, during which time the loss due to evaporation is constantly made up by fresh supplies of mother-liquor, the transformation is complete, the liquid contains the whole of the nitrate of potash in solution, and the solid salt consists of fine crystals of chloride of sodium. From the solution, clarified by settling, pulverulent saltpetre is obtained by disturbed crystallisation, and freed by washing from adherent chloride of sodium. The salt is also washed in a similar manner till free from saltpetre. The mother-liquors and washing-waters are used in the treatment of fresh quantities of Chili saltpetre and chloride of potassium, and with careful working are said to be completely used up.

Other methods for the industrial conversion of sodium nitrate into potassium nitrate are probably no longer in use. In an early process the potash salts from the manufacture of beet-root sugar were utilised. The aqueous solution contains principally potassium sulphate, chloride, and carbonate, and sodium carbonate. On concentration

\* “Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends.”

† C. Nöllner, *Journ. Prakt. Chemie*, cii., 459; *Wagner Jahresber.* 1868, 290.

‡ Wöllner, *Polyt. Notizbl.*, 1860, 49; *Wagner Jahresber.*, 1860, 204. H. Grüneberg, *Wagner Jahresber.*, 1869, 208.

§ H. Grüneberg, *Polyt. Notizbl.*, 1868, 968; *Wagner Jahresber.*, 1868, 288.

|| Nöllner, *Polyt. Notizbl.*, 1867, 370.

¶ Anthon, *Dingler*, cxlix., 39; *Chem. Centralblatt*, 1858, 560; *Wagner*, 1858, 154.

\* Kuhlmann, *Bull. Soc. d'Encouragement*, 1859, 567; *Wagner*, 1859 182.

† Waltl, *Polyt. Central.*, 1859, 129; *Wagner*, 1859, 182.

‡ Lunge, *Dingler*, clxxxii., 385; *Wagner*, 1866, 223.

to specific gravity 1.38 (40° B.) the sulphate of potash separates out whilst the liquid is hot, and the greater part of the chloride on cooling. The mother-liquor separated from these salts was mixed with Chili saltpetre and concentrated further, when carbonate of soda mixed with more or less chloride of sodium was deposited and fished out. The clear mother-liquid on cooling deposited potash saltpetre in crystals.

Another method, proposed by Landmann,\* was in use for some time in England, and was also employed by Nöllner† at Billwerder, near Hamburg, at the time of the Crimean war. It depends on the decomposition of caustic potash and Chili saltpetre, yielding caustic soda and potash saltpetre. The latter is crystallised out, and the former evaporated down, and sold as lump caustic soda. According to an account by G. A. Scherf‡ the following rather circumstantial process is used in America for the simultaneous production of potash saltpetre and baryta-white, by reason of the heavy duty on salt and the high price of hydrochloric acid. Chili saltpetre is converted by chloride of barium into nitrate of barium and chloride of sodium. Stassfurt chloride of potassium is converted into sulphate of potassium and hydrochloric acid by heating with sulphuric acid, and the sulphate of potassium thus obtained is finally converted by treatment with the barium nitrate into potash saltpetre and baryta-white.

We have still to mention Delafield's§ proposal for the simultaneous manufacture of white-lead and potash saltpetre. He precipitates a boiling solution of nitrate of lead with carbonate of potash, when a carbonate of lead, agreeing in composition and properties with white-lead, is thrown down, whilst potash saltpetre remains in solution, and may be obtained by concentration.

In the technological analysis of nitrate of potash the chlorine is generally determined volumetrically by means of silver nitrate, with chromate of potash as indicator; the sulphuric acid gravimetrically as barium sulphate; the potassium as the double platino-chloride, and the water and insoluble constituents by direct weighing. From these data the composition is calculated. A special examination must be made for sodium nitrate. This is most conveniently carried out according to the proposal of Nöllner,|| by moistening a portion of the sample—not too small—with a little water, evaporating the solution to dryness, moistening the saline residue again, and re-evaporating the lixivium. The whole amount of the very soluble soda saltpetre may be in this manner collected in a very small quantity of liquid, so that it may be easily recognised by its rhombohedral crystalline form, and especially by its characteristic optical behaviour under the microscope with the polarising apparatus. If it is desired to determine the nitric acid, this is for technological purposes best effected by mixing the sample intimately with sugar, graphite,¶ or oxalic acid, and igniting after the addition of from 4 to 6 parts of common salt. The fused mass is lixiviated with water, and the carbonate formed is determined volumetrically with normal sulphuric acid, from which the nitrate is easily calculated. A number of other methods have been proposed, which in experienced hands give accurate results, but which are either too circumstantial for practical use, or without due care may easily lead to serious errors.

The applications of potash saltpetre in the manufacture of gunpowder, and of the nitrates in fireworks, are known. Latterly, Chili saltpetre has been used according to the suggestion of Knowles, made as early as 1858,\*\* by Hargreaves,†† Heaton,‡‡ and Bessemer.§§ for the decarboni-

sation of cast-iron in the manufacture of steel, and, according to the opinion of Schinz\* and Gruner,† has given satisfactory results. R. Wagner,‡ calls attention to the applicability of nitrate of soda in the metallurgy of copper and nickel, for the removal of sulphur from the concentrated ores, and of arsenic from the nickel speiss.

*Nitric Acid.*—In the industrial preparation of nitric acid Chili saltpetre and common sulphuric acid are exclusively used, and none of the numerous proposals for obtaining it in any other manner have been carried out on the large scale. The respective proportions of sulphuric acid and of soda saltpetre are not alike in all manufactories, some using but little more sulphuric acid than the equivalent of the nitre, whilst others to 1 equivalent of nitre take as much as 1.3 equivalent of sulphuric acid. In the former case the residual sulphate is very sparingly mobile, and must be taken out of the retorts in lumps when cold. In the latter case the bisulphate formed reduces the melting-point of the residue so far that it can be easily run off in a liquid state.

(To be continued.)

## ON A PROCESS FOR THE ELECTRICAL DEPOSITION OF METALS, AND FOR CONSTRUCTING METAL-COVERED GLASS SPECULA.§

By Prof. ARTHUR W. WRIGHT, Yale College.

IN a paper by the writer, published in the *American Journal of Science and Arts*, January, 1877, an account was given of a method of producing metallic films upon the inner surface of exhausted glass tubes, by the action of a succession of energetic electrical discharges. The thickness of these films could be varied, from a tenuity such that the coating barely gave indications of a metallic lustre, and scarcely dimmed the intensity of transmitted light, to the point where perfect opacity was attained, by simply continuing the action of the current for a shorter or longer time. They were produced by forming the negative electrode of the metal to be deposited, exhausting the tube, and passing through it the current from an induction coil. The metallic coatings thus obtained, as seen from the exterior, were very brilliant, but the condition of the inner surface was not readily observed, and the nature of the process made it seem probable that they possessed a dull or even frosted surface. With a view to obtain the films in a form better suited for examination, a modification of the apparatus was contrived, by which they could be deposited upon pieces of plane glass. At first this object was attained by inserting narrow slips of glass into the tube by the side of the electrode, in the manner suggested in my former paper, and very good results were gained. But, as the nearer portion of the plate received a larger share of the metal, the thickness of the deposit was not uniform, and it was found necessary to construct a special apparatus, in which the relative positions of the plate and the electrode could be varied, so as to give the latter an equal action upon all parts of the surface to be covered. The plan employed was as described in the following paragraphs.

A rather thick-walled glass globe, about 7 centimetres in diameter, blown upon the end of a tube 25 centimetres long and 15 m.m. in diameter, was used to form the receiver. The top of the globe opposite the tube was cut off, so as to form an opening 40 m.m. in diameter, and the edge ground flat, in a plane perpendicular to the axis of the tube. The end of the latter was drawn somewhat

\* Landmann, *Dingler*, cxvii., 78. † Nöllner, *Polyt. Notizbl.*, 1867, 370.

‡ Scherf, *Wagner*, 1866, 227.

§ Delafield, *CHEM. NEWS*, 1866, xiv., 178.

|| Nöllner, *Polyt. Notizbl.*, 1867, 306; *Dingler*, clxxxvi., 333; *Wagner*, 1867, 241.

¶ Abel and Bloxam, *Chem. Soc. Quarterly Journal*, x., 107.

\*\* Knowles, *Repert. Patent Inv.*, 1858, 239; *Dingler*, cxlix., 317; *Wagner*, 1858, 14.

†† Hargreaves, *Mech. Mag.*, 1868, 11, 30; *Dingler*, clxxxvii., 480; *Wagner*, 1868, 84.

‡‡ Heaton, *Dingler*, clxxxvi., 489; *Wagner*, 1868, 87.

§§ Bessemer, *Prakt. Mech. Journ.*, 1868, 143; *Dingler*, cxc., 32; *Wagner*, 1868, 88.

\* Schinz, *Dingler*, cxcv., 126; *Wagner*, 1870, 70.

† Gruner, *Comptes Rendus*, lxx., 521; *Wagner*, 1870, 70.

‡ R. Wagner, *Wagner's Jahresber.*, 1870, 116, 151.

§ From the *American Journal of Science and Arts*, vol. xiv., September, 1877.

smaller in a gas-flame, and a glass stop-cock attached to it with cement. A little way above this, a platinum wire was fused into the glass to serve as the positive electrode. The cover of the vessel was made by cutting from a similar globe a portion corresponding in size to the part removed, but with the neck attached, the two pieces being carefully ground so as to fit closely. When they were placed together a little cement applied to the outside along the line of juncture rendered the joint perfectly air-tight. The tube or neck of the cover was 5 centimetres long, and was also somewhat reduced at the extremity by drawing it smaller. Into this was cemented a small and thick-walled tube, extending to a point near the centre of the globe. A platinum wire was placed in this tube, and was fused in at the top, enough being left projecting to form a small loop for the attachment of the wire from the coil. The inner end of the wire terminated at about 1 centimetre from the lower end of the glass tube. Into the latter was slipped a wire of the metal to be deposited, which, in all cases, was the negative electrode—the part within the tube being long enough to make good contact with the platinum wire, and being bent somewhat so as to cause it to retain its place by friction. In some of the experiments a different cover was used, made from a glass funnel, the neck of which was left somewhat longer to afford more room for the swinging electrode, as described below, and the tube carrying the latter was fitted into the top by grinding so as to make an air-tight joint.

For the support of the plate a small watch-glass, about 3 centimetres in diameter, was employed, to one edge of which a thread of glass was fused by a blowpipe flame, and then bent so as to form a loop by which it could be suspended like the pan of a balance. A small hook of glass was also attached to the side of the thick tube carrying the electrode, and upon this the pan was hung, the loop being so formed as to allow it to swing freely in all directions. The pan, when in place, was about 15 m.m. below the end of the tube from which the electrode projected, the latter being adjusted to the proper distance by sliding it up or down in its support as occasion required. By slightly inclining the globe the extremity of the wire could thus be readily brought over any point of the plate. In some of the experiments the plate was stationary, being held in a little tripod of glass threads, or simply laid upon the bottom of the globe. In these cases the tube holding the electrode was jointed near the top, the two portions being connected by a hook and loop of platinum or magnesium wire. It could thus be made to traverse all parts of the plate by giving suitable movements to the globe.

When adjusted and closed the receiver was attached to the Sprengel pump. By means of a small air-pump of the ordinary construction, connected with this by a stop-cock and flexible tube, the whole apparatus was exhausted as far as possible and then dry hydrogen admitted, this being repeated two or three times in order to remove the air and moisture. The process of exhaustion was then completed with the mercury pump. The degree of rarefaction required varied somewhat with the metal to be deposited, but was rarely above 2.5 m.m. For platinum the best results were obtained, when it was from 1.5 to 1.75 m.m. The use of hydrogen is not in all cases necessary, as some of the metals can be deposited perfectly well with only air in the receiver. This is especially the case with gold, but platinum, although ordinarily not easily combined with oxygen, becomes tarnished with a film of what apparently is the blue oxide, unless the air is removed. The electrode itself was formed of a small wire, usually not more than one-fourth of a millimetre in thickness, bent at the end into a circle 3 or 4 m.m. in diameter, the plane of which was perpendicular to the straight portion of the wire entering the glass tube, and parallel with the surface of the glass plate situated beneath it. Its distance from the latter was generally about 3 m.m., though considerable variations were possible. When it is farther away the process of deposition goes on much

more slowly, though the results are in most cases quite as good as when it is nearer. After the process of exhaustion was completed, the stop-cock was closed, and the apparatus removed from the pump, for greater convenience of manipulation in applying the current.

The electrical apparatus employed consisted of an induction-coil capable of giving sparks 4 or 4 centimetres in length, and a battery, the power of which could be varied according to circumstances. It consisted usually of pint Grove cells, from three to six in number, not completely filled, or charged with rather weak acid, and a plunge battery of five cells, of which one, two, or more were used, as occasion required, the whole being joined in a continuous circuit. By immersing the plates of the plunge battery more or less, as well as by varying the number in the circuit, the strength of the current could readily be changed within the limits desired. The various metals required currents of different strength, and the power best suited to each had to be determined by trial. It was found advisable in most cases to regulate it so that the temperature of the electrode was below that of a red heat, or such as barely to redden it. Of course with the more fusible metals it was necessarily much lower than this. The metal is actually volatilised by the discharge, as is shown by the fact that the characteristic lines of its spectrum may be seen with a spectroscope, and the film is formed by the condensation of its vapour upon the cooler glass surface. For the production of films with brilliant surfaces, the strength of the current must not be great enough to give the discharge a disruptive character, as this separates some of the metal in the form of powder.

The primary object of the experiments was to obtain films of the different metals upon thin pieces of flat glass for the purpose of investigating some of their optical characters. The apparatus proved to be perfectly successful in its operation, and beautiful films of gold, silver, platinum, and bismuth, were obtained with ease and certainty. As has been mentioned, it seemed probable that the surface of deposit would be dull, but the first trial showed that this anticipation was incorrect, and the films when removed from the receiver exhibited surfaces of exquisite perfection and the most brilliant polish. They can only be compared to the surface of clean liquid mercury, far surpassing in lustre anything that can be obtained by the ordinary methods of polishing.

This circumstance suggested at once a valuable application of the process in the production of specula for optical purposes, and the subsequent investigations were directed to this end. The mirrors first made had been formed upon disks of thin glass, such as are commonly used as covers for microscopical objects, those being selected which were most free from defects, and had the best surfaces. By means of a very delicate assay balance, the weight of the glass disks, both before and after receiving the deposit, could be obtained to the one-hundredth part of a milligram, and hence it was easy to calculate the thickness of the metallic layer in any instance. By this means the relative transparency of the different metals can be determined, and the relation between the amount of light transmitted and the thickness of metal traversed by it. The more particular consideration of these and some other matters of interest as bearing upon the optical characteristics of the metals is deferred to another time, and it is only necessary to mention here the results of some measurements which were made in order to determine the limiting thickness of a film in regard to the transmission of light, that is, the thickness of a film which would allow only an inconsiderable proportion of the incident rays to pass through. As the metallic lustre is developed gradually with the increasing amount of metal, showing conclusively that light actually penetrates these substances to a certain depth, it was important to ascertain whether the thickness of the layer, sufficient for a virtually complete reflection of light, would be great enough to affect perceptibly the figure of a mirror of glass upon which it was laid down.

Experiments for this purpose were made with gold and platinum, and the process of deposition was continued until the films appeared to have just reached the condition of complete opacity. On removing them from the receiver, however, it was found in both cases that a very small amount of light was still transmitted, as, on holding them close to the eye, a brilliant object, like the sun or a bright flame, could be seen through them. The thickness of the gold layer was found to be 0.000183 m.m., that of the platinum 0.000174 m.m., or approximately one-fourth the length of a wave of light at the red end of the spectrum. The gold, although thicker than the platinum, transmits perceptibly more light, showing that it is the more transparent of the two metals. As the films employed for mirrors may be much thinner than the amount mentioned without an appreciable diminution of the intensity of reflected light, it is evident that the figure of a perfectly wrought-glass mirror will not be changed, when the metal is uniformly deposited, to such an extent as to affect its performance unfavourably. A platinum film of one-fifth the thickness of the one described forms a brilliant mirror, transmitting but a very small percentage of light. The perfect control of the process obtained by the use of the movable electrode will even make it possible to apply the method of local correction for the improvement of a defective figure, or to parabolise a spherical mirror by depositing the metal in a layer increasing in thickness toward the centre, though, of course, it would be better to avoid a somewhat tedious operation by securing the perfect form of the glass beforehand.

Of the metals that are suitable for the formation of specula, platinum appears to be the most valuable. For while, when well polished, it is but little inferior to silver in reflecting power and freedom from colour, it does not become tarnished by oxidation or the action of sulphurous gases, and when dulled by atmospheric deposits the surface can be cleaned by washing with water or with acids, which is an important advantage. By the method here described it can be deposited upon glass surfaces very easily, and a mirror of the most perfect surface produced at once, without the necessity of a single touch, to complete it. Several such mirrors have been made in the course of these experiments, by the use of concave glass lenses, with the most satisfactory results. The metal film adheres strongly to the glass, and when of sufficient thickness appears to be very firm and hard. In mirrors silvered by the ordinary method, trouble is often experienced from the insinuation of moisture between the glass and the metal, resulting finally in the separation of the latter. In those prepared by the new process the adherence of the film is so close as to render such an effect impossible. As a test of this, a small silvered speculum was placed in a beaker of water where it remained for two weeks, and besides this was wetted and dried repeatedly, without showing the slightest tendency to suffer the penetration of the moisture. Similar results were also obtained with platinum and gold films.

With silver the process likewise succeeds well, but it is more difficult to obtain good surfaces than with gold or platinum. The metal is volatilised with extreme ease by the action of the current, and the energy of the discharges must not be too great. Of several trials made with this metal the most successful was one in which not only the degree of exhaustion of the receiver was less than had been employed in other cases, being only to 3 m.m., but the electrode was more distant from the plate, and the battery weaker. The action proceeded slowly in this instance, but with the result of producing an excellent film. With a stronger current the deposit is rapidly made, and has a fine lustre, but the surface has a yellowish colour. This is perhaps partially due to a slight degree of oxidation, but also appears to be owing in part to the deposition of a portion of the metal in the form of fine powder, the vapour of the silver as it streams from the electrode toward the more distant portions of the plate becoming partially condensed, and falling on it in minute

particles. That such a result would follow from this cause was shown by some of the experiments in which a rather strong battery was employed. The whole interior surface of the globe was in a short time covered with the powdered metal, appearing an intense purple where thinnest, and shading gradually to deep blue where thickest, the colour being the same by both transmitted and reflected light. The metallic lustre was wanting, though it was readily developed when a portion of the powdery coating, which was easily removed, was rubbed against the surface of the glass with some pressure. The defect was, to a considerable extent, remedied by surrounding the electrode with a small glass tube projecting some 3 m.m. beyond it, so as to clear the surface of the plate by an interval of only 1 or 2 m.m. This had the effect to cut off the lateral portion of the discharge, and to confine its action to a limited area immediately below the extremity of the wire.

The yellow tarnish is removed with the greatest ease by gently rubbing the surface with soft chamois leather and a little rouge, and the metal is so hard that when this operation is performed with care the polish is not at all, or but very slightly, affected. Even then, however, the metal is not perfectly white, having still a very faint yellow tinge. It is well known that silver is not a perfectly white metal, for light which has undergone repeated reflections from polished surfaces of this metal appears yellow or reddish yellow, though this colour is not perceptible when the light has undergone but a single reflection. But the real cause of the yellowish tint may possibly be found in the very tenuity of the films, which when prepared in this way have a beautiful and intense blue colour by transmitted light. When not too thick, the amount of blue rays which they suffer to pass may be sufficient to cause, by their abstraction, a perceptible tinge of yellow, the complementary colour, in the reflected rays. If this were really the case the colouration should grow weaker with an increase of thickness, and disappear when opacity is reached. Some of the results obtained seem to favour this view, and the probability of its correctness is strengthened by the facts related in the next paragraph, but further experiments are needed to decide the question satisfactorily.

One result of the investigation has been to show that the colour of the light which has passed through a layer of metal varies somewhat with the thickness of the film. This was known to be the case with gold, and experiment has shown it to be true of platinum and bismuth also. Thus the latter in a very thin film appears a clear bluish-gray, while a much thicker film appears brownish. Platinum in a thin layer has a greyish tint, which varies, as the film is made thicker, to a peculiar brownish shade, somewhat like that of sepia, passing into brownish yellow, and finally becoming a deep yellow, even inclining somewhat to orange in the thickest films obtained. Now this colour is almost exactly complementary to that transmitted by silver, and the possibility suggested itself of making a mirror which should be perfectly white by reflected light, by depositing first a thin stratum of silver and over this another of platinum, the relative thickness of the two being properly regulated by observing the colour of the transmitted light. An experiment made with a circular disk of flat glass was perfectly successful, the platinum being readily deposited upon the silver, the yellowish tint of which it entirely removed, producing a white and brilliant reflecting surface. By transmitted light the film, as it was anticipated would be the case, has a pure neutral tint, with no perceptible colour of any kind.

The value of such a combination for specula is evident, for though until careful measurements are made, it cannot be asserted that the absolute reflecting power is increased, the whiteness of the layer and the protection afforded by having the surface covered with an unalterable metal, are very substantial advantages. In constructing large mirrors it will probably also be found to result in a material saving of time, the silver being so much more

rapidly and easily deposited than the platinum. The process can also be used with great advantage for the construction of solar eye-pieces for telescopes, since the compound film can be deposited directly upon the surface of the lens, and made thick enough to reduce the intensity of the light as much as may be desired. An image nearly or quite colourless could thus be obtained, and the disturbance of the rays should be less than that produced by the interposition of a dark glass of the ordinary kind.

As has been mentioned, some experiments were made with bismuth, and a mirror of excellent surface was obtained, but the metal is inferior to platinum in brilliancy, and has a decided colour. The great facility with which films are obtained with it might recommend its use for mirrors in some cases, but for most purposes other metals are to be preferred. Attempts to produce mirrors of iron and nickel were but partially successful, as it was difficult to prevent tarnishing by oxidation. Some good iron films were obtained, however, which were very brilliant. They were exceedingly hard, and adhered to the glass with such tenacity that at first it seemed as if they had been fused into it. But when the film was dissolved off by an acid the glass was found not to have been acted upon at all. A singular characteristic of the iron in this condition is its chemical inertness. Films prepared more than six months ago and freely exposed to the air, which, for a part of the time too, was excessively charged with moisture, have not shown the least alteration. Nitric acid placed upon one of them for a short time produced scarcely any effect, and nitro-hydrochloric acid acted upon it with about the same readiness as it does upon platinum. This may be due to the extreme thinness of the film, in consequence of which, even the exterior atoms of the iron, being within the range of the molecular action of the glass, are held by a force tending to oppose and neutralise the attraction of reagents that ordinarily attack the metal energetically.

It is not at all necessary that the object upon which the metal is deposited should be of non-conducting material. This is shown by the fact that the process continues to go on after the glass has become covered with a perfectly continuous layer of metal of considerable thickness. The success of the experiment of covering a silvered glass with platinum is additional evidence of the same fact. In order more fully to test the question whether a deposit could be made upon a solid piece of metal, a small silver coin was placed in the pan under an electrode of gold. It was covered in a few minutes with a beautiful coating of the latter metal, which was found to be very hard and to adhere perfectly, having also, in every respect, its proper colour and lustre. At the beginning of the process, while still thin enough to allow light reflected from the silver to pass, it had a greenish colour, producing a curious effect.

As an example of the applicability of the process to practical purposes, it may be of interest to mention the results of some experiments in the construction of a small Gregorian telescope, the specula of which were covered with platinum by the method described, and with entire success. The larger mirror has a diameter of a little less than 4 centimetres, and both this and the smaller one, so far as the nature of the surface is concerned, appear absolutely faultless. As only common lenses were employed in its construction the performance of the instrument is not remarkable, but it is sufficiently good to warrant the assurance that the method will be serviceable for the production of specula of exquisite quality for optical purposes. The size of the apparatus, which, for convenience in experimenting, was necessarily small, did not permit the introduction of larger mirrors than this, but there seems to be no reason for doubting that much larger specula can be successfully made in this way. The amount of time required for obtaining the platinum covering of this mirror was about three hours, during which the coil was kept in continuous action, with a battery power equivalent to four or five small Grove cells. Mirrors of larger size would of course require a longer

time, but with suitable apparatus a much stronger battery and larger coil could be used, which would materially accelerate the operation. A plate 2 centimetres in diameter can be covered with platinum in twenty or thirty minutes sufficiently thick to form a good speculum. For gold or silver the time would not be more than from ten to fifteen minutes.

Many useful applications of this process may be found, and its use is not limited to those metals which have been mentioned here. Moreover, for many of them no other available process is known by which they can be deposited in a uniform layer and with a brilliant reflecting surface upon glass. A very thin layer of platinum, or still better of silver and platinum together, could be used with great advantage in the *camera lucida* and similar instruments. Very perfect mirrors for galvanometer needles, and for delicate torsion apparatus, can be expeditiously formed in this way, and by the use of very thin glass, or the most delicate films of mica, they may be made of almost inappreciable weight. For the mirrors of heliostats, and other reflecting instruments in which a metallic surface is necessary, the specula produced by this method will be especially valuable. For telescopes, the beautiful process of Liebig and Foucault, for forming silvered glass specula, is recommended by the ease with which it is applied, and the rapidity of its operation. But the perishable nature of the delicate silver film, and the difficulty of securing a firm and permanent adherence, are serious disadvantages. These are entirely avoided by the use of an unalterable metal like platinum; and though for instruments of the largest size the process here described may be found impracticable, for those of more moderate dimensions there is every reason for believing it may be employed with complete success. The labour and time required for its application are indeed drawbacks; but there is compensation for this in the important circumstance that the mirror comes out of the receiver with a surface of inimitable perfection, which would in fact only be injured by any of the ordinary methods of polishing.

Yale College, August 8, 1877.

## CORRESPONDENCE.

### THE READY COMBUSTIBILITY OF MANGANESE SULPHIDE.

To the Editor of the Chemical News.

SIR,—Since I sent you the communication which appeared in the CHEMICAL NEWS (vol. xxxvi., p. 113) "On the Action of Alkali-waste on Manganese Chloride, and the Spontaneous Ignition of Manganese Sulphide," I have found that I was not the first to notice this property of manganese sulphide, but that it has been observed still earlier by Dr. R. Angus Smith, F.R.S. This notice would have been forwarded sooner but for the intervention of a variety of circumstances which prevented my writing it.—I am, &c.,

WATSON SMITH, F.C.S.

Akademie Strasse, Heidelberg,  
October 6, 1877.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 13, Sept. 24, 1877.

This issue is entirely taken up with the orations delivered on occasion of the death of M. Leverrier.

*Moniteur Scientifique Quesneville.*  
October, 1877.

**Researches on the Substances of the Anthraquinon Group.**—MM. E. Schunck and H. Roemer.—These researches have been published eighteen months ago in the *Berichte der Deutschen Chem. Gesell.*, and in the *Memoirs of the Philosophical Society of Manchester*. Three notes, treating respectively of the derivatives of naphthalin, of normal propyl-benzin and propyl-phenol, and of propyl-iso-propyl-benzin and the propyl-benzoic and homoterephthalic acids are taken from back issues of the *Gazzetta Chimica Italiana*.

**Theory of Colours applied to the Arts and to Industry.**—This is a notice of a work by Prof. Bezold of the Polytechnic School of Munich, an English edition of which has been brought out in America. The author objects to Chevreul's arrangement of colours, and maintains that the principle of the chromatic colour does not agree with the laws of the mixture of colours. "In fact the admixture of black is equivalent to a decrease of intensity, for the abated colours obtained by this mixture may also be obtained by illuminating more and more feebly a surface painted with a pure colour. We know that when the day declines all colours darken and become converted into black. But, on the other hand, an admixture of white is not equivalent to an augmentation of intensity, for the whitened colours are not pure colours intensified; they are colours imperfectly saturated. M. Chevreul confounds under the name of "ton" two modifications essentially distinct. The chromatic circle also does not contain the gamut of white, *i.e.*, the series of grey shades which represent the mixtures of white and black, nor do we find in it the mixtures of the colours with white and black at once. An attempt has been made to correct this imperfection of the chromatic circle by adding nine chromatic circles uniformly lowered with black, but in this manner many colours are necessarily repeated several times in the successive circles." M. Bezold proposes to revert to the "chromatic cone" of Lambert, the construction of which agrees with the principles established by Helmholtz and Maxwell. On these principles every sensation of colour depends on the factors by which it is completely determined; for these we may take:—1. A pure colour defined by its wave-length (Chevreul's *nuance* and Helmholtz's *ton*). 2. The luminous intensity of this colour, which may be determined by the quantity of black to be added to the normal shade. 3. The degree of saturation or of purity, which depends on the quantity of white to be mixed with the normal colour. To obtain all the colours possible it is needful to form a chromatic circle with a certain number of distinct colours distributed on the extreme circumference, and degraded successively by admixture with growing proportions of white, to the centre which is occupied by white. We then form a similar series of circles by successively diminishing the luminous intensity of the colours contained in the first by an admixture of black. For the colours to be placed on the circumference of the circle M. Bezold takes in the outset the following ten, which form five pairs of complementary colours:—Red and green-blue; orange and blue; yellow and ultramarine; yellow-green and violet; green and purple. The wave-lengths of the two complementary colours are to each other about 4 to 5; but we remark that the purple, a compound colour not existing in the spectrum, is not defined by its wave-length. M. Bezold admits that the difference between the yellow-green, the green, and the blue-green is much less sensible than that which exists between their complementary colours, violet and purple, or purple and red. He therefore subdivides the violet into blue-violet and purple-violet, and the red into carmine and scarlet, thus obtaining a scale of twelve equidistant colours.

**Protection of Inventions in Science and Industry.**—M. A. Lermite.—An account of the Congress on Patent Right held in connection with the Vienna Exhibition.

Mr. Macfie, one of the leaders of the party which in England seeks to deprive inventors of all property in their own ideas, was not personally present, but in a written communication he spoke of the "injurious activity" of inventors, and assured the Congress that a spirit hostile to patents was beginning to prevail "upon the wool-sack." (We hope that since 1873 the wool-sack and even Mr. Macfie may have learned better). His contention was annihilated by the speech of the American commissioner, the Hon. J. M. Thacker.

**On Salicylic Acid and the Salicylates.**—Prof. Germain Sec.—A medical essay of no especial chemical interest.

**Analysis of Products containing Glucose, and Determination of Sugar in Coloured Substances.**—MM. H. Pellet and L. Pasquier.—Not capable of useful abstraction.

**Manufacture of Artificial Butter.**—Dr. H. A. Mott.—The author maintains that the product manufactured from animal fats is "as good as the greater part of butters if not equal to the best products of cream." His comparative analysis of the natural and the artificial kinds, shows, as is to be expected, a considerable difference. In genuine butter butyric, caproic, capric, and caprylic amount to 7.606 per cent, whilst in the factitious article they only occur to the extent of 0.262 per cent.

*Biedermann's Central-Blatt für Agrikultur Chemie,*  
Heft 8, August, 1877.

**Investigations on the Propagation of Heat in the Soil by Conduction.**—Dr. Emil Pott.—Quartz conducts heat best, humus and clay take an intermediate place, and carbonate of lime is the worst conductor. A dense compact soil conducts heat better than a loose soil. One and the same soil when moist conducts heat better than when dry. The influence of the thermic conductivity of a soil upon its temperature appears hitherto to have been overestimated.

**Influence of Manures upon the Nature of the Seeds Produced by the Kidney-bean, *Phaseolus vulgaris*.**—Dr. Gustav Mark.—The manures experimented with were kainit, nitrate of soda, bone dust, superphosphate, gypsum, guano, kainit and bone dust, kainit and gypsum, kainit and nitrate of soda, guano and bone dust, and farm-yard manure. One plot was left unmanured. The heaviest yield of beans was given by bone dust and the next by superphosphate. Kainit with nitrate of soda, kainit with gypsum, guano with bone dust, guano alone, and farm-yard manure gave worse results than the unmanured plot. Guano appears to have an injurious action. The nitrogenous manures increased the percentage of albumenoids; kainit favours the productions of the hydrates of carbon. The plot manured with stable-dung gave seeds of the lowest specific gravity.

*Gazzetta Chimica Italiana,*  
Anno vii., 1877, Fas. viii. and ix.

**Periclasiferous Predazzite of Monte Somma.**—Prof. Alfonso Cossa.—The crystals of periclasite contain:—

Magnesia	..	..	..	..	95.39
Ferrous oxide	..	..	..	..	4.56
					99.95

The rock freed from these crystals is composed of:—

Carbonic acid	..	..	..	..	40.28
Lime	..	..	..	..	45.73
Magnesia	..	..	..	..	9.32
Ferrous oxide	..	..	..	..	0.41
Water	..	..	..	..	3.97
					99.71

**Detection and Determination of Carbonic Acid.**—Egidio Pollacci.—The author figures and describes a

modification of the apparatus of Kipp which he has adopted for the analysis of carbonates.

**New Researches on Asparagin.**—J. Guareschi.—In this continuation of his researches the author examines succinamic uramidic acid, and the behaviour of sulpho-carbamid with asparagin.

**Penta-phenyl-chloretan and other Products of the Action of Sodium upon Tetra-chloro-methan and Mono-bromo-benzine.**—J. Guareschi.—Not adapted for abstraction.

**On Tribromo-acetamid.**—J. Guareschi.—A reclamation of priority as to the discovery of this substance.

**Furfuramid and Furfurin.**—R. Schiff.—The author describes the preparation of furfuramid and furfurin, their behaviour with anhydrous acetic acid, with nitrous acid,

nascent hydrogen, and the oils of mustard, and the action of bromine upon acetyl-furfurin.

**Some Derivatives of Cymen.**—E. Paterno and C. Colombo.—In this preliminary notice the authors speak of the mercuric compound  $(C_{10}H_{13})_2Hg$ , and of the sulph-acid of bromo-cymen.

**Temperature of Flame.**—F. Rossetti.—The flame of a mixture of two volumes of coal-gas with three of carbonic acid gave a maximum heat of  $1000^{\circ}$ . One volume of coal-gas with two of carbonic acid gave  $860^{\circ}$ , whilst the maximum temperature reached with the flame of one volume of coal-gas and three of carbonic acid was  $780^{\circ}$ . Mixtures of coal-gas and atmospheric air decrease in heat if the proportion of the latter exceeds what is necessary for combustion.

## COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

SEPTEMBER, 1877.

THE following are the returns of the Society of Medical Officers of Health:—

Appearance in 2 foot Tube.	Ammonia.		Nitrogen as Ni- trates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Sulphuric An- hydride.	Hardness on Clark's Scale.	
	Saline.	Organic.								Before Boiling.	After Boiling.
	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
<i>Thames Water Companies.</i>											
Grand Junction .. ..	Clear	0.001	0.009	0.090	0.100	20.80	8.960	0.396	0.86	1.330	13.7 3.30
West Middlesex .. ..	Clear	0.000	0.009	0.111	0.048	17.30	7.280	0.320	0.86	1.200	12.6 3.00
Southwark and Vauxhall	Clear	0.002	0.010	0.118	0.110	19.70	8.400	0.430	0.79	1.200	13.2 3.30
Chelsea .. ..	Slightly turbid	0.001	0.009	0.105	0.092	21.00	8.170	0.360	0.79	1.460	14.3 3.30
Lambeth .. ..	Clear	0.001	0.009	0.130	0.079	20.70	9.080	0.390	0.94	1.330	13.7 3.00
<i>Other Companies.</i>											
Kent .. ..	Clear	0.000	0.002	0.268	0.010	26.60	10.860	0.930	1.44	3.530	19.4 5.10
New River .. ..	Clear	0.000	0.006	0.090	0.017	16.10	7.840	0.360	0.94	0.870	12.6 3.30
East London .. ..	Clear	0.000	0.007	0.099	0.041	20.00	7.840	0.320	0.94	1.260	12.6 3.00

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY, M.B.

## MISCELLANEOUS.

**American Devotion to Science.**—We have repeatedly had occasion to refer to the great interest in the advancement and diffusion of science prevalent in the United States, and to the exertions in that direction made by the Federal Government, by State and Municipal authorities, and by private citizens, whose liberality in founding and endowing colleges, observatories, laboratories, &c., has been most strikingly manifest. As a further proof of this zeal for scientific education we may mention that the Massachusetts Institute of Technology has provided special laboratories for the instruction of women in chemistry—analytical, industrial, and physiological; in botany, mineralogy, microscopic manipulation, &c. To illustrate the fact that good work is done in this department, we need only refer to an excellent paper by two ladies on the determination of nickel in pyrrhotites and mattes, which is inserted in our issue for October 5.

## TO CORRESPONDENTS.

J. W. McMalcolm.—Messrs. Trübner publish "A Practical Treatise on the Manufacture of Soaps," by Campbell Morfit, M.D., F.C.S. The price is £2 12s. 6d.

C. W. Eacott.—We do not know.

ERRATA.—P. 159, bottom of col. 2, for "*x*" read  $\times$ . P. 160, col. 2, lines 4 and 18 from bottom, and p. 161, col. 2, line 3 from top, for "*m.m.*" read "*millionths of a millimetre.*" Fig. 2 read "*strength in grms.*" In figs. 3, 4, and 5 the engraver (who failed to supply the cuts until the day of publication) has omitted the absorption-bands.

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# THE CHEMICAL NEWS.

VOL. XXXVI. No. 934.

## REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.\*

By Dr. A. W. HOFMANN.  
(Continued from p. 170.)

*Nitric Acid and its Salts.* By Dr. ADOLPH GEYGER, of Berlin.

THE degree of concentration of the sulphuric acid is regulated according to the strength of the nitric acid to be prepared. Ordinarily, sulphuric acid is used at specific gravity 1.718 (60° B.), as obtained by concentration in lead pans. Experience has proved that with this strength the mixture froths least, so that the retorts may be charged tolerably full. The average strength of the nitric acid thus obtained varies with the quantity of sulphuric acid used and the heat applied, but ranges in general between specific gravity 1.38 to 1.41 (40° to 42° B.). For the preparation of weaker kinds this acid is diluted with water, which is placed previously in the condensing apparatus. For stronger nitric acid a more concentrated sulphuric acid must be taken, and for nitric acid of specific gravity 1.50 to 1.53 (48° to 50° B.), which almost corresponds to the pure monohydrate, dried Chili nitre, and oil of vitriol at specific gravity 1.85 (66° B.) must be used.

The apparatus employed consists in general of horizontal cast-iron cylinders, set so that they may be enveloped as equally as possible in the hot furnace-gases. In some works an attempt is made to protect the upper half of the cylinder from corrosion by the acid by means of a lining of bricks or a coating of fire-clay. This arrangement is, however, useless if the iron is kept so hot that no nitric acid can be condensed upon it. The expedient may even have an injurious effect, since the porous mass of clay is less strongly heated than the metal, and easily retains a portion of nitric acid which, when the cylinder cools, may attack the iron. The two ends of the cylinder are not exposed to the fire, and are therefore best closed with plates of sandstone luted with a mixture of iron-filings, sal-ammoniac, sulphur, and vinegar. This luting sets rapidly, and resists the action of the fire and of the acid very well. The front end slab has in its upper half an aperture which serves for the introduction of the nitre, and can be closed with a stone stopper luted with clay. In this stopper is a smaller orifice, through which, when everything else is arranged, the sulphuric acid is run in by means of a lead pipe. At the lower part of the front of the cylinder there is a concavity with a hole 8 centims. in diameter, through which the liquid sulphate of soda is removed at the end of the operation. During the process this hole is closed with a cast-iron stopper luted with clay. The back stone slab is perforated to receive a fire-clay pipe, which connects the interior of the cylinder with a series of stoneware jars which serve as condensers. The uncondensed gases are passed into a coke-tower, where they encounter a descending shower of water, which condenses the last traces of nitric acid, and with the joint action of air converts into nitric acid any hyponitric acid present. The stoneware vessels (*bombonnes*) are generally of the same form as those used for hydrochloric acid. Each has two wide apertures for the connecting pipes, and a smaller one for drawing off the acid.

Devers and Plisson\* have modified the form of the condensing apparatus, so that two jars are placed one above the other in such a manner that the upper is fitted like a funnel into the middle aperture of the lower. The acid as it condenses flows into the lower jar, and from there through a syphon luted in, to a large receiver. At the end of the condensing plant there are still several jars placed upon each other, and filled with fragments of pumice in which the hyponitric acid is condensed by a current of water. If about equal equivalents of sulphuric acid and nitre are used, the residual sulphate of soda, as has been already mentioned, is not sufficiently mobile to flow out. The front end of the cylinder is then closed with a cast-iron plate, protected within by a lining of clay. The plate is luted with a mixture of clay and horse-dung, as the iron-lute mentioned above sets too hard. Before charging the cylinder some prismatic bars of cast-iron with sharp edges are laid at the bottom. On these the cake of sodium sulphate breaks as it cools, and can thus be easily taken out in pieces.

Instead of the cylinders many manufacturers use cast-iron troughs, whose sides are lined with sandstone plates, or with blocks of stone, and which are closed above with a sandstone slab or with a double arch. This arrangement is less advantageous, the outlay in fuel is greater, and the apparatus itself is more readily corroded by the acid.

A preferable construction is a large cast-iron boiler, with a wide aperture above for the introduction of nitre and sulphuric acid, and closed during firing with a cast-iron lid. The boiler is set so as to be exposed to the flames all around and even above the lid. The nitric acid is led to the condensers by a neck cast on to the boiler, and lined with a stoneware pipe as a protection against the action of the acid. The soda sulphate is run out through a pipe cast at the bottom of the boiler. The liquid sulphate is best received in iron boxes standing on small iron trucks, and conveyed away immediately. When cold it is broken in pieces, and converted into neutral sulphate (salt-cake) for the alkali manufacture by ignition with common salt.

The nitric acid as produced is always tinged more or less with yellow, owing to the presence of hyponitric acid, and contains an amount of hydrochloric acid corresponding to the proportion of chlorine in the nitre employed. It is, further, often contaminated with traces of sulphuric acid, sulphate of soda, ferric oxide, and iodine. To prepare chemically pure nitric acid, the tetrahydrated acid at specific gravity 1.42 (43° B.) is distilled in glass retorts, and the liquid which first passes over is kept separate as long as it produces a turbidity with a solution of silver nitrate. The receiver is then changed, and the acid is distilled over down to a small residue.

For many technical purposes it is requisite to have nitric acid free from chlorine, whilst the other impurities, when present in small quantity, have no prejudicial effect. Some establishments, for this purpose, wash the Chili nitre with pure water—or, better still, with a saturated solution of nitre free from chlorine—until all the common salt is removed. Others prefer to remove the chlorine after the acid is prepared, which is easily effected by heating the acid in stoneware pans in a water-bath, and simultaneously forcing a current of air through it by means of an air-pump. The escaping hyponitric acid containing chlorine is conducted into a coke-tower. In this manner the nitric acid is obtained as clear as water, and free from chlorine and hyponitric acid.

R. Wagner proposes† to employ in the preparation of nitric acid the hydrated alumina obtained as a by-product in the treatment of cryolite and bauxite. If this is ignited with Chili nitre, nitric and hyponitric acids escape, the latter being utilised by treatment with air and water. The residual aluminate of soda is decomposed with carbonic acid into carbonate of soda and hydrate of alumina, the

\* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

\* Schwarzenberg, "Nitric Acid," in Bolley's "Technologie," ii., 1, 2, 304. Brunswick: 1865.

† R. Wagner, *Wagner's Jahresber.*, 1865, 249.

latter being utilised in the decomposition of fresh quantities of nitre. Instead of the hydrated alumina, Wagner thinks it possible to use finely-divided silica, as obtained on the decomposition of soluble glass or of fluoride of silicium. This method, proposed as early as 1865 by Wagner, has subsequently been twice patented in England, in 1867 by J. Poole, W. Stase, and H. Baker,\* and in 1870 by J. H. Johnson.† As far as known to the author, this method has not been carried out on the large scale.

Tessié du Motay‡ proposes to pass a mixture of ammonia and oxygen over manganates, permanganates, and chromates heated to 340° to 560°, decomposing the nitrates thus formed by air and steam at a red heat, when nitric acid is liberated, and the chromates or manganates are regenerated. Like so many other suggestions of this much-inventing chemist, the process has not come into industrial utilisation.

R. Weber§ has recently made known a method for obtaining Ste.-Claire Deville's anhydrous nitric acid easily and in quantity. He adds anhydrous phosphoric acid to the refrigerated monohydrated nitric acid, and distils at a gentle heat. The distillate consists of two non-miscible liquids. The upper stratum is decanted off and cooled below 0°, when crystals of nitric anhydride are formed in abundance. According to Weber's statement, confirmed by Berthelot,|| the yield is very satisfactory.

A very sensitive test for nitric acid is sulphate of brucin, which gives an intense red colour. On adding stannous chloride a violet precipitate is produced.

According to the statement of C. D. Braun,¶ confirmed by Böttger,\*\* sulphate of aniline is equally sensitive with the brucin salt. A solution of aniline sulphate is prepared by dissolving 10 drops of aniline in 50 c.c. of dilute sulphuric acid (1:6). Half a c.c. of this solution is then placed in a watch-glass, mixed with 1 c.c. of concentrated sulphuric acid, and a glass rod moistened with the liquid to be tested is drawn through the margin of the mixture. In presence of nitric acid red stripes appear, and the whole liquid gradually turns of a rose colour. If more nitric acid is present the colour becomes a deep red-brown, and finally a brownish yellow. According to Reichardt,†† 1 part of nitre dissolved in 1000 parts of water gives no reaction with the aniline solution, whilst 1 part of nitre in 100,000 parts of water gives a very distinct colouration with brucin.

For the determination of small quantities of nitric acid in potable waters a great number of methods have been proposed. Recently, F. Tiemann‡‡ has made very accurate comparative experiments on the determination of nitric acid in the analysis of water. He arranges all the methods in four classes.

I. Methods which depend on the transformation of the nitric acid into ammonia in an alkaline solution and in presence of a metal. F. Schulze§§ first based a method upon this principle, and effected the reduction by platinised zinc. Voit,||| Harcourt,¶¶ and Siewert\*\*\* employ zinc and iron filings; Bunsen,††† a spiral of zinc-iron; and Chapman,‡‡‡ aluminium-foil. In all these cases the ammonia generated is isolated by distillation, and if in large quantity determined by means of a standard acid,

but if in small traces by means of Nessler's test. According to Frühling's statements,\* confirmed by Tiemann, the methods based upon this principle give inaccurate results in presence of organic matter. Finkener† observed that all the nitric acid was decomposed, but that in no case was all the nitrogen completely converted into ammonia.

II. Determination of the nitric acid by reduction to nitric oxide and re-conversion into nitric acid. This method, proposed first by Schlösing,‡ and then modified by Reichardt,§ depends on the reduction of nitric acid to nitric oxide by the action of ferrous chloride and hydrochloric acid, oxidation of the nitric oxide to nitric acid by means of oxygen and water, and titration of the acid with a dilute soda solution. Schlösing receives the nitric oxide gas over mercury, whilst Reichardt applies soda-lye, which according to his experiments absorbs mere evanescent traces of nitric oxide.

III. Methods which determine nitric acid by measurement of the nitric oxide evolved. Walter Crum,|| as also Frankland and Armstrong,¶¶ decompose the nitrates in a highly concentrated solution by concentrated sulphuric acid, and reduce the liberated acid to nitric oxide by agitation with mercury. Crum measures the nitric oxide in the decomposition-tube, whilst Frankland and Armstrong make use of a gasometric apparatus. Like Schlösing, F. Schulze\*\* decomposes the nitrates with hydrochloric acid and ferrous chloride, and receives the nitric oxide, liberated on the application of heat over moist mercury, determining the quantity by measurement. This method, which according to Wulfert†† and Tiemann gives very accurate results, has been modified by the latter,‡‡ who employs soda-lye in place of mercury.

(To be continued.)

## THE ACTION OF HYDROCHLORIC ACID ON THE METALLIC SULPHATES.

Communicated by Prof. ALBERT B. PRESCOTT.

To find certain constants of the decomposition of the inorganic sulphates by hydrochloric acid, under stated condition, a series of quantitative determinations was instituted. The results already obtained and here given are from the work of Messrs. A. L. Young and G. F. Dixon, done in the laboratory under my instruction.

The conditions fixed upon were as follows:—To 1.000 grm. of the sulphate, in a porcelain evaporating dish, were added 3.5 c.c. of hydrochloric acid of sp. gr. 1.153 (1.251 grms. of HCl with 2.784 grms. of water, as 4.035 grms. of aqueous acid). This quantity of hydrochloric acid gives a chemical excess of chlorine, ranging from 2.2 and 2.3 to 5.4 times the quantity required to displace the sulphuric acid radical. (The least excess of chlorine occurs with the ammonium and calcium salts; the greatest excess with the silver salt.) The material was then evaporated on the water-bath to apparent dryness, stirring with a glass-rod at the close of the evaporation, and, to remove free hydrochloric acid, three portions of 4 c.c. of water were added with evaporation to dryness in the same way after each addition, when the last dry residue was left one hour on the water-bath. The entire operation on the water-bath continued about five hours.

The formation of chloride was estimated gravimetrically as silver salt; the residue of final evaporation being

\* *Deutsche Industrie Zeitung*, 1867, 158; *Wagner Jahresber.*, 1867, 998.

† J. H. Johnson, Specification 2866, October 31, 1870. (The process was tried experimentally in England about 1850 at the works of Messrs. Metz and Halcrow, Droylsden, near Manchester, but was not considered remunerative.—Ed. C.N.)

‡ *Deutsche Industrie Zeitung*, 1871, 388.

§ R. Weber, *Pogg. Ann.*, cxviii., 113; *Berl. Chem. Gesell.*, 1872, 804.

|| Berthelot, *Bull. Soc. Chim.*, 1873; *Ber. Chem. Gesell.*, 1873, 1560.

¶ *Zeit. Anal. Chemie*, 1867, 71; *Wagner's Jahresber.*, 1867, 197.

\*\* *Jahresber. Phys. Vereins Frankfurt*, 1866-67, 18. *Wagner's Jahresber.*, 1868, 254.

||| *Arch. Pharm.*, [2], cxlv., 108. *Jahresber. d. Chemie*, 1871, 893.

†† *Ber. Chem. Gesell.*, 1873, 1034.

§§ F. Schulze, *Chem. Centralblatt*, 1861, 657 and 833.

||| Voit, *Chem. Centralblatt*, 1862, 379.

¶¶ Harcourt, *Chem. Soc. Journ.*, xv., 385.

\*\*\* Siewert, *Ann. Chem. Pharm.*, cxxv., 293.

††† Bunsen, *Zeit. f. Analyt. Chemie*, 1870, 414.

‡‡‡ Chapman, "Sutton's Volumetric Analysis," second edition, 80.

\* Frühling, "Landwirth. Versuchsst.", viii., 473.

† Rose, *Anat. Chem.*, sixth edition, ii., 829.

‡ Schlösing, *Ann. Chim. Phys.*, [3], xl., 479; *Journ. Prakt. Chem.*, lxii., 142.

§ Reichardt, *Zeit. Anal. Chemie*, 1870, 24.

|| Crum, *Ann. Chem. Pharm.*, lxii., 233.

¶ Frankland, *Chem. Soc. Journ.*, [2], v., 6, 77.

\*\* Schulze, *Zeit. f. Analyt. Chemie*, 1870, 401.

†† Wulfert, *Dissert. T. Phil. Fac.*, Rostock.

‡‡ Tiemann, *Ber. Chem. Gesell.*, 1873, 1041.

reated with a large quantity of water, any part not soluble being filtered out and washed, the solution acidulated with nitric acid and precipitated with silver nitrate, the washed precipitate dried in the dark, and weighed as silver chloride, from which was calculated the weight of chloride of the metal under investigation. The operation on silver sulphate was of course shorter, the chloride formed by action of hydrochloric acid being taken for weight. The quantity of *sulphate remaining intact*, as given in the table, was calculated from the quantity of chloride found to be formed. In a few cases the sulphate in the filtrate from the silver chloride was precipitated as barium salt and its weight obtained—not, however, with any confidence that the free sulphuric acid had been fully expelled, and normal sulphates obtained in the repeated evaporations on the water-bath. These direct determinations of residual sulphate are here put in comparison with the calculated quantities of undecomposed sulphate as placed in the table farther on:—

	Residual Sulphate found from Barium Salt.	Undecomposed Sulp- Calculated from Chloride formed.
$\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ { 0.870 0.868 0.871 }	0.8696	0.807
$(\text{NH}_4)_2\text{SO}_4$ .. ..	0.9010	0.898
$\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$ ..	0.9020	0.895

The lead sulphate left insoluble on treating with water, after the action of the hydrochloric acid, was found to be 0.992 (from triplicates, 0.995, 0.991, 0.990); the amount calculated from the chloride being also 0.992.

The operations of treatment with hydrochloric acid and determination of metallic chloride produced, as above described, were all made in triplicate, each result in the table being a mean of three parallel determinations.

*Production of Chlorides by treating 1.000 grm. of each Metallic Sulphate with 4.035 grms. of Aqueous Hydrochloric Acid containing 1.251 grms. of HCl (3.5 c.c. of acid of 1.153 sp. gr.) and evaporating to dryness on the Water-bath.*

Sulphate taken.	Quantity of Chloride formed.	Quantity of Sulphate not Decomposed.	Proportion of Metal changed to Chloride.
	Grm.	Grm.	Per cent.
$\text{Ag}_2\text{SO}_4$ .. ..	0.920	None	100
$\text{HgSO}_4$ .. ..	0.915	..	100
$\text{Bi}_2(\text{SO}_4)_3$ .. ..	0.027*	0.836*	*
$\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$ ..	0.070	0.807†	19.3
$\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$	0.042	0.895†	10.5
$(\text{NH}_4)_2\text{SO}_4$ .. ..	0.083	0.898	10.2
$\text{CoSO}_4$ .. ..	0.072	0.914	8.6
$\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ .. ..	0.019	0.964†	3.6
$\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$ .. ..	0.013†	0.977†	2.3
$\text{CdSO}_4$ .. ..	0.017	0.981	1.9
$\text{ZnSO}_4 \cdot 7\text{H}_2\text{O}$ .. ..	0.007	0.990†	1.0
$\text{PbSO}_4$ .. ..	0.007	0.992	0.8
$\text{MnSO}_4 \cdot 4\text{H}_2\text{O}$ .. ..	0.004	0.992†	0.8
$\text{K}_2\text{SO}_4$ .. ..	0.006	0.993	0.7
$\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ .. ..	0.003	0.995†	0.5
$\text{Sb}_2(\text{SO}_4)_3$ .. ..	None	1.000	—
$\text{CaSO}_4$ .. ..	..	1.000	—
$\text{SrSO}_4$ .. ..	..	1.000	—
$\text{BaSO}_4$ .. ..	..	1.000	—

The considerable production of aluminium chloride seems to contradict the well-known instability of aluminium chloride, and invites more investigation, particularly as

\* On treating with water, after the evaporation of the hydrochloric acid, a residue was obtained consisting of bismuth, sulphate, and chloride united, and the weight of this residue (0.836) is given in the column of undecomposed sulphate. The "0.027" is only the chloride found in the filtrate.

† Stated in quantity of crystallised salt of the formula of the sulphate taken.

‡ Found to be ferric chloride, and taken as such in calculation of the sulphate left.

to the formation of sulphate and chloride in one compound.

I hope to present at another time the results of treating the sulphates with hydrochloric acid under other conditions of concentration, temperature, and proportion; also the products of chlorides with sulphuric acid.

University of Michigan, Ann Arbor,  
August 31, 1877.

## DESTRUCTION OF LEATHER BY GAS.

By Prof. A. H. CHURCH.

THE injurious influence of the products of combustion of coal-gas upon the leather bindings of books is only too well known. Vellum seems unaffected; morocco suffers least; calf is much injured, and Russia still more so. The disintegration is most rapid with books on the upper shelves of a library, whither the heated products of combustion ascend, and where they are absorbed and condensed. By comparing specimens of old leather with specimens of new it is quite clear that the destructive influence of gas is due mainly to its sulphur. True there are traces of sulphates in the dye and size of new leather bindings, but the quantity is insignificant, and there is practically no free sulphuric acid. That leather may be destroyed by the oil of vitriol produced by the burning of gas in a library is proved by the following observations and analyses.

The librarian of one of our public libraries forwarded to me the backs of several volumes which had been "shed" by the books on the upper shelves in an apartment lighted by gas. The leather of one of these backs (a volume of the "Archæologia") was carefully scraped off so as to avoid removing any paper or size from beneath. This task of scraping was easy enough, for the leather was reduced to the consistency of Scotch snuff. On analysis of the watery extract of this leather the following figures were obtained:—

Free sulphuric acid in decayed leather	..	6.21 p.c.
Combined .. ..	..	2.21 ..
Total .. ..	..	8.42 ..

## THE PROPOSED CARBOLIC TEST FOR NITRIC ACID.

By DAVID LINDO.

In testing minute quantities of nitrates in the solid state by this method, transfer the substance to a small porcelain capsule, and dissolve it in two or three drops of the carbolic solution (5 grains to the ounce),\* then add cautiously three or four drops of concentrated sulphuric acid.

If the colour is not very full at first, this may arise from the amount of nitrate being too large for the quantity of carbolic solution employed, in which case the addition of a little more of the latter will greatly improve the reaction.

In testing *solutions* supposed to contain traces of nitrates, a very good method is to mix 30 minims of the suspected fluid with the same bulk of pure and highly concentrated sulphuric acid in a small porcelain basin.

Give the vessel a slight rotatory motion to ensure complete mixture, and *at once* pour a small quantity of the carbolic solution gently down the side of the dish, so

\* The easiest way of preparing the carbolic solution is to place the bottle containing the crystallised acid in warm water, and when the crystals are fused, use 5 minims of the fluid to each ounce of distilled water. This will be a little more than 5 grains, which is of no consequence. The water of course must be heated to take up the acid.

that it may spread over the surface of the hot mixture. If the dish is left undisturbed, the colour soon appears if nitric acid is present.

By proceeding in this way, I have easily detected the nitric acid in 30 minims of a solution of one grain of nitre in 20 ounces of distilled water, and I have obtained faint reactions with a solution of half this strength.

But if the temperature of the mixture is allowed to fall before adding the carbolic solution, the experiment will fail with these minute traces of nitrates, and by applying heat afterwards, you will rarely succeed in developing the colour in a satisfactory manner.

When applying the test the other way—that is by mixing the carbolic solution with sulphuric acid, and adding two or three drops of the nitrate solution—it is perhaps preferable to mix the carbolic solution with an equal volume of concentrated sulphuric acid, instead of with three times the quantity as formerly prescribed.

If strong hydrochloric acid is mixed with some carbolic solution, and a little nitric acid added, no colour is observed at first, or only yellow, but on applying heat the magenta colour appears. Boiling the mixture destroys the colour. The same results are obtained with nitrates, but sulphuric acid is much to be preferred to hydrochloric in making use of the reaction as a test for nitric acid.

Chlorates, iodates, chromate of potash, ferricyanide of potassium, and other oxidising agents, if added to the mixture of carbolic and sulphuric acids, produce olive, yellowish green, and dirty brown colours, which, in no way resemble, and therefore cannot be mistaken for, the colours obtained with nitric acid. The presence of any of these substances however, would of course interfere more or less with the action of the test.

I may here state that I have been unable to trace the changes that take place when these three acids are brought together in the manner described.

The action of nitric acid alone on carbolic acid is well understood, but it appears that some reaction not hitherto recorded takes place between these two substances in the presence of another and more powerful acid. Possibly some organic base is formed which unites with the stronger acid, in which case the highly coloured fluid obtained would be a solution of the salt thus produced in the excess of strong acid. I should like, however, to see the matter fully explained, as this would greatly assist in determining the true value of the reaction as a test for nitric acid.

Falmouth, Jamaica, September 18, 1877.

## PROCEEDINGS OF SOCIETIES.

### RUSSIAN CHEMICAL SOCIETY.

June, 1877.

F. WREDEN, "*Hydrogenisation of Benzene and its Homologues.*" Berthelot's reaction with HI has been carefully studied, and the results would show the inability of benzene and its homologues to assume more than six additional atoms of H, as well as establish the existence of a series  $C_nH_{2n}$ , the members of which, like those in the methane series, cannot enter into direct combination, and are marked by a stability against reagents and a tendency toward complicated reactions. Toluene yielded hexa-hydro-toluene,  $C_7H_{14}$ , a colourless mobile liquid, boiling at  $94^\circ$  to  $100^\circ$ . Hexa-hydro-isoxylol,  $C_8H_{16}$ , was obtained in a similar manner.

A. LENTZ, "*By-products in the Manufacture of Illuminating Gas from Wood and Petroleum.*" The residues are found to contain the same constituents as those derived from coal, viz., aromatic hydrocarbons and phenols, naphthalin, anthracen, and phenanthren; all of which are

likewise obtained by conducting petroleum through red hot tubes filled with charcoal.

W. MARKOWNIKOFF, "*Derivatives of Normal Pyruvic Acid.*" The anhydride has been obtained by the action of acetyl chloride on the silver salt. It crystallises in white fine needles, melts at  $56^\circ$ , and resembles succinic anhydride in many properties. It forms with acetic anhydride a compound crystallising in needles an inch long. When left in contact with alcohol it forms the acid ethylic pyruvate, a thick acid liquid. The anhydride is prepared in an impure form by heating the acid alone.

K. LISSENKO, "*Calorific Power of Naphtha.*" Some forms of petroleum which yield a less amount of heat on combustion than calculated are regarded as containing hydrocarbons of the series  $C_nH_{2n+2}$ , accompanied by small quantities of non-saturated hydrocarbons.

A. ORLOWSKY, "*Synthetic Preparation of Ethenyl-tricarbonic Acid.*"

G. GUSTAVSON, "*Penta-bromo-toluen, and Decomposition of Cymene by Bromine in the Presence of Aluminium Bromide.*" By the addition of bromine containing a small quantity of  $Al_2Br_6$  to toluene at  $0^\circ$ , penta-bromo-toluen is obtained,  $C_6Br_5CH_3$ , easily crystallised from benzene, melting at  $282^\circ$ , and subliming in crystals like those of  $C_6Br_6$ . The same reaction with cymene yields, likewise, penta-bromo-toluen, and isopropyl bromide.

## NOTICES OF BOOKS.

*A System of Volumetric Analysis.* By Dr. EMIL FLEISCHER. Translated, with Notes and Additions, from the Second German Edition. By M. M. PATTISON MUIR, F.R.S.E. London: Macmillan and Co.

THE first question which will be asked by the student in taking up this work is—What distinctive features does it present? In reply, the author and the translator tell us that their object has been, not to give an encyclopædia of recipes for volumetry, but to lay before the student such methods only as are trustworthy and simple, doing away with or modifying all uncertain final reactions. Dr. Fleischer, we learn, attempts to divide volumetric processes into a few great groups, pointing out definitely the principles on which each group is based, and illustrating the application of such principles by well-chosen practical examples. The methods proposed for volumetric separations will deserve the careful attention of analytical chemists. To develop such methods has been the author's chief object, and he calls on his readers to pursue the path which he has thus opened up. Volumetric processes are in this work divided into the following sections:—Analysis by saturation, including alkalimetry and acidimetry; analysis by oxidation and reduction, including oxidimetry and iodometry; and, lastly, analysis by precipitation. As concerns the last class, the author has abandoned all volumetric precipitation analyses except those the termination of which can be determined by a sudden change in colour, or those which may be used conjointly with an oxidation or saturation method. For the standard solutions used in alkalimetry and acidimetry hydrochloric acid and ammonia are recommended, the former being employed as normal and the latter as semi-normal. His experiments have proved that the value of a normal hydrochloric acid is unaltered after being kept for half a year, and that no acid reaction is obtained with litmus-paper placed in the steam given off by decinormal or even one-fifth normal acid kept at a boil for ten minutes. The semi-normal ammonia solution is practically unaltered in value after being preserved in stoppered bottles for four months, and in three months no carbonic acid is absorbed. As an indicator, after carefully examining a number of recently proposed substitutes he gives the preference to litmus, or to tincture of cochineal. The latter, being much less affected by carbonic acid than is litmus, is therefore preferable in the titration of alkaline

carbonates. In the presence of salts of iron or aluminium—or, as we might more generally say, of metals capable of acting as mordants or alterants—cochineal does not give trustworthy indications. "Tincture of georgia" is a substance which will probably puzzle the reader, or any dealer in reagents to whom he may apply. We beg therefore to state that "georgia," or "georgina," is the German name for the flower known among us as the dahlia, a tincture of the dark purple varieties of which has been proposed as an indicator. Dr. Fleischer gives the important caution that in working with the standard ammonia solution the liquids should be perfectly cold, since ammoniacal salts, especially the sulphate, have the power of feebly reddening litmus in warm solutions. In the estimation of copper Dr. Fleischer reduces to suboxide with tartaric acid, caustic alkali, and glucose, dissolves in a solution of pure ferric sulphate, and deduces the quantity of copper present from the amount of ferrous salt produced.

The separation and determination of cobalt and nickel is thus effected. The acid solution of the two metals is decomposed by caustic soda and chloride of soda in excess; the black precipitate is filtered off, boiled with dilute ammonia, and again filtered. The residue, containing all the cobalt and a part of the nickel as  $\text{NiO}$ , is treated with a known volume of ferrous sulphate, and subsequently titrated with permanganate. The cobalt being thus determined, the mixed sesquioxides are next precipitated in a fresh portion of the original liquid, and the precipitate is treated with ferrous sulphate *without* a previous boiling in ammonia. On titrating with permanganate the joint quantity of the two metals is found, from which the weight of nickel is of course readily calculated.

The second part of the book is devoted to methods of separation as preliminary to volumetric determinations. The first section treats of the separation of the bases from each other; the second, of the estimation of the bases without separation of groups or of individual bases; and the third of the separation and estimation of the more important acids. It seems to us that there is in this region room for much useful work, and that volumetric analysis has before it a future greater than has been generally supposed. The author's method is to separate each base in turn from a solution which may contain all the bases, reverting to the original solution, which is to be divided into as many portions as there are bases, or groups of bases, to be determined. He remarks that "The process of analysis is thus much shortened, not only by the omission of group separations, but also by the fact that but one, or at the most two, filtrations are necessary; in many instances no filtrations are required. The precipitates do not require the same long-continued washing which consumes so much time in the ordinary processes. Two circumstances more especially recommend the methods under consideration. Every estimation is readily controlled by repeating the process on the original liquid; the analyses of technical products in which one or more, but not all, the constituents is to be determined, becomes a matter of ease, and can be carried out much more rapidly than when it is necessary to make a systematic separation of the metallic groups." The author's process is worked out for twenty metals in a table, which we cannot conveniently here insert, but for which we would bespeak careful study and experimental trial.

The third part of the book gives instructions for the quantitative analysis of certain substances of especial technical importance.

In the appendix Mr. Pattison Muir adds the figure and description of a simple and ingenious arrangement for rapid filtration, which no doubt many of our readers will find useful.

In speaking of potable waters the author, or the translator—for we are not quite sure to whom the responsibility for the closing paragraph belongs—remarks that—"The ammonia process appears to be exceedingly useful in measuring comparatively the quantities of decomposing organic matter in water. When we attempt to measure

organic matter which has not begun to decompose, or organic matter (such as peaty matter) which only decomposes with difficulty, the process cannot be relied upon. Of course it is decomposing organic matter which is especially—harmful."

One unfortunate point in the work before us is that the author and translator do not agree. Dr. Fleischer, like Fresenius, is an upholder of the notation employed, *e.g.*, in Gmelin's "Handbook of Chemistry," whilst Mr. Pattison Muir is an uncompromising adherent of the notation and nomenclature employed in the so-called "new chemistry." We do not see that a treatise on chemical analysis—gravimetric or volumetric—is the place for discussing this "very pretty quarrel." In the case before us the difficulty has been compromised by inserting the formulæ according to *both* systems, which must have somewhat added to the cost of producing the book. In spite, however, of this misfortune, the work must be pronounced a valuable addition to English chemical literature. It abounds in practical hints and precautions calculated to guard the student against possible inaccuracies; it is plain, intelligible, and compendious, and unburdened with the introduction of alien matter. All chemists who have occasion to make use of volumetric processes will find Dr. Fleischer's work a useful laboratory companion.

*The Lazy Lays and Prose Imaginings.* Written, printed, published, and reviewed by W. H. HARRISON. A.D. 1877 (Popular Chronology). A.M. 5877 (Torquemada). A.M. 50,800,077 (Huxley). London: 38, Great Russell Street.

WHEN a work is sent to us for review we naturally infer that it in some way or other professes to deal with scientific questions. In the present case the inference is corroborated by the fact that some portion, both of the poetry and the prose herein contained, touches on chemical and physical subjects. Thus we find a "Lay of the Photographer," and a poem on the Appointment of a Public Analyst at Folkestone, and essays on "Materialistic Religion" and on "Wirbel-bewegung," the two latter of which are certainly well worth reading, and commend themselves to the sympathies of all such men of science as do not fancy themselves wiser than what is demonstrated. But there is much in the book painfully puzzling. Why do we find, on the very title-page, the name of Torquemada selected as an authority for the shorter date of the earth's existence, and that of Huxley for the longer? Does any deep meaning lurk in the "Song of the Pawnbroker," the "Lay of the Fat Man," or the "Lay of the Broad-brimmed Hat"? What—save on the question of Materialism, where he speaks plainly—is the author's point of view? What does he seek to prove, and what to disprove? Wanting light on this question, how can we decide whether or no he has made out his case? Even in the "Public Analyst" it is impossible to ascertain whether Mr. Harrison is or is not ridiculing public analysts in general or the gentleman who holds the Folkestone appointment in particular. The "Lay of the Photographer," too, has its mysteries, in spite of the marginal comments. Why is Prof. Clifford classed among the "poor relations" of Pyroxylin? And why are "Odling and Caithness" selected to bear in the dead? The "Lay of the Mace-bearers" promises some jokes at the cost of—

— "a great British Association for plastering Science *en masse*  
On the back of the nation at large, went to see  
This superior Mayor with his Mace-bearers three."

But the promise is not fulfilled.

In a poem entitled "The Castle" Mr. Harrison tells us that—

"O'er the race of humanity Freedom is dawning,  
And a happier time for mankind is at hand."

The man who can at present entertain such a belief must

even surpass Mark Tapley in the faculty of being jolly under creditable circumstances!

*Elements of Chemistry, Theoretical and Practical.* By W. ALLEN MILLER, M.D., &c., late Professor of Chemistry, King's College, London. Revised by H. MCLEOD, F.C.S. Part I. Chemical Physics. Sixth Edition. London: Longmans and Co.

DR. MILLER'S work is so generally—and we may add so favourably—known to the majority of chemists in this country that any explanation of its character and peculiarities would be quite superfluous. The present edition has been brought up to the present state of knowledge by the addition of notices of the most recent discoveries in each branch of chemical physics. The section on polarised light—an agent of great value to the chemist in the study of certain organic compounds—has been considerably enlarged and modified. The account of the researches of Dr. Andrews on thermo-chemistry—the heat evolved on the combination of bodies—and on the condensation of gases, have been carefully revised by their author. Those numerous chemists who refuse to recognise the principle that “a rose by any name will smell as sweet” will be glad to learn that “an attempt has been made to bring the terminology of the work into accord with the views of the present time.” What is of much greater importance, all references have been re-verified, all numerical statements—as far as possible—re-calculated, and a number of incidental inaccuracies thus detected and removed.

After a careful examination of this volume we may fairly congratulate the editor on the complete, and at the same time compact, manner in which the results of the latest research have been here embodied. We have always found it a good rule first to refer to Miller, if in search of some piece of chemical or physico-chemical information not everywhere to be met with, and we feel little doubt that in its present enlarged and improved form it will merit this character still more decidedly than before.

*A Course of Scientific German.* By H. B. HODGES. Boston: Ginn and Heath.

Now Latin has ceased to be the language in which discoveries and researches are revealed to the world—with the sole exception of entomology, where it still exists as an anti-Darwinian case of the survival of the unfittest—every man of science finds it increasingly necessary to be acquainted with the three leading languages of the world, English, French, and German. Mr. Hodges has observed that many students who have paid considerable attention to the German language still find great difficulty in reading the German scientific journals. This difficulty he ascribes to the fact that at schools and colleges the student of a foreign language is made acquainted with its polite literature, and with the words and phrases of daily life, to the exclusion of the language of the laboratory and the workshop. Such complaints are especially applicable to the German language, since its technical terms, as used in the sciences and the arts, differ greatly from the corresponding English or French expressions. To remedy this evil Mr. Hodges has prepared a course of German intended to familiarise the student with the special terms, the phraseology, and the style he will meet with in German scientific works and journals. The reader, who is supposed to have a general knowledge of the language, will find first a series of exercises in German and English, selected from standard text-books on physics, chemistry, mineralogy, and botany, each exercise being preceded by a vocabulary of technicalities, and followed by questions to be answered in either language, as the case may be. Next follow scientific essays taken from the writings of Liebig, Helmholtz, &c., whilst a glossary—German-English and English-German—concludes the work. In the glossary we have, after a very careful examination,

found merely two slight errors. “Mikroskop,” not Mikroscope, is a neuter, not a feminine noun, and in the English-German department “tumeric” is incorrectly put for “turmeric.” We should have considered this a mere typographical error had not the word been placed in accordance with the unusual orthography here adopted. Many words seem to us, however, superfluous, such as soda, borax, blende, calcium, gas, gold, &c.: these might safely have been omitted, and many others—though having no similarity to English technical terms—are by no means peculiar to scientific literature, and can scarcely fail to be familiar to every student of the German language.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 14, October 1, 1877.

**Boric Acid: Methods for its Detection; its Origin and Mode of Formation.**—M. L. Dieulafoy.—Spectrum analysis, under the conditions laid down by the author, permits us to detect with certainty the presence of  $100 \pm 5$  of a gm. of boron. The method with the hydrogen flame as described by the author shows distinctly the existence of  $100 \pm 1$  of a gm. of boron. Boric acid is a normal constituent of the waters of existing seas. Contrary to what might have been expected boric acid concentrates itself in the last mother-liquors of the salt-marshes, above the carnallite in the deliquescent salts, in the state of borate of magnesia. But it is exactly in that place and under these conditions that boric acid is met with at Stassfurt. The borate of magnesia of this celebrated deposit therefore is not, as commonly admitted hitherto, of volcanic origin, but is purely sedimentary. The presence of boric acid can be shown in a single drop of natural sea-water.

**Discovery of Oxygen in the Sun, and New Theory of the Solar Spectrum.**—M. H. Draper.—Already noticed.

**Magnetisation of Tubes of Steel.**—M. J. M. Gauguain.—Not adapted for abstraction.

**Exact Measure of the Heat of Solution of Sulphuric Acid in Water.**—M. Crouillebois.—The heat varies from 4554 calories at  $10^{\circ}$  to 2420 at  $24^{\circ}$ .

**Continuation of Researches on the Effects Produced by Electric Currents of High Tension and on their Analogies with Natural Phenomena.**—M. G. Planté.—This paper would be imperfect without the accompanying illustrations.

**Some New Researches on the Metal Davyium.**—Sergius Kern.—See CHEMICAL NEWS, vol. xxxvi., page 114.

**New Methods of Formation of Oxide of Ethylen.** M. H. Greene.—Silver oxide reacts very readily upon ethylen iodide at  $150^{\circ}$  and yields ethylen oxide. With bromide of ethylen and oxide of silver ethylen oxide is produced in like manner, but the reaction requires a much higher temperature ( $250^{\circ}$ ). Bromide of ethylen reacts very distinctly with oxide of sodium at  $180^{\circ}$ , and yields oxide of ethylen.

**Note on Drawing Platinum Wire.**—M. A. Gaiffe.—The author finds that if atmospheric dust is carefully excluded during the operation of drawing platinum wires, the wire is more tenacious.

*Bulletin de la Societe Chimique de Paris,*  
Nos. 6 and 7, October 5, 1877.

Certain Properties of the Sulphides of Platinum considered from an Analytical Point of View.—M. J. Ribau.—Already noticed.

Studies on Glycerine, Cellulose, and Gum: Transformation of Glycerine into Glucose.—M. C. Kosmann.—Reserved for insertion in full.

Influence of the Alkalinity of various Substances upon the Rotatory Power of Sugar.—M. H. Pellet.—The author finds that there is no relation between the action of alkalis upon sugar and their equivalent, and agrees with Sostmann that their influence upon the rotatory power of sugar is greater in concentrated than in dilute solutions.

The greater part of these issues consists of papers from the *Berichte der Deutsche Chem. Gesells.*, from *Liebig's Annalen*, and from the *Comptes Rendus*, which have been already noticed under their respective heads.

Constant Presence of a Sulphocyanic Compound in the Urine of the Carnivora.—M. R. Gscheidlen.—The amount of sulphocyanogen excreted daily in the urine of a man is from 0.004 to 0.032 m.grm.—(*Pflüger's Archiv.*)

Presence of Alcohol in the Organism.—M. A. Rajewski.—The author having injected some rabbits with alcohol and distilled their bruised organs with water, obtained the reaction of iodoform in all cases. But he also obtained the same reaction from rabbits which had not received any alcohol and which had been operated upon as a check experiment. Hence the detection of alcohol by this method is not trustworthy in the case of these animals.—(*Archiv. der Physiologie.*)

Presence of Methylamin in the Organism.—M. H. Schwartz.—On distilling fecal matter with lime the author obtained ammonia mixed with a small quantity of methylamin.—(*Chemisches Centralblatt.*)

On Urobilin.—M. J. Essoff.—The author describes a process for the isolation of urobilin. Of 39 specimens of urine 4 displayed directly the absorption-band of urobilin, and 35 only after the addition of a mineral acid. Oxidising and reducing agents destroy urobilin, but it is not affected by fermentation.—(*Archiv. der Physiologie.*)

Formation of Glycogen in the Liver.—M. von Mering.—Glucose, sucrose, lactose, inverted sugar, inulin, lichenin, glycerin, arbutin, gelatin, and the albuminoids promote the formation of the glycogen. Inosit, quercit, and the fats do not produce it.—(*Pflüger's Archiv.*)

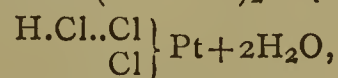
Examination of Commercial Salicylic Acid.—M. H. Kolbe.—The author dissolves  $\frac{1}{2}$  grm. in 5 c.c. of alcohol, pours the solution which ought to be clear into a watch-glass, and allows it to evaporate in the air. The salicylic acid then remains in the form of a ring of crystalline efflorescence. This ring is white if the salicylic acid is of good quality and has been purified by crystallisation; if the acid has been merely precipitated the ring is yellowish or yellow; but if it is brownish or brown, then, even though the powder may be white, the salicylic acid is impure and unfit for medicinal use.

*Journal für Praktische Chemie.*  
Nos. 6 and 7, 1877.

Hippuric Acid and its Derivatives.—W. Conrad.—The author has made a very extensive study of this acid, subjecting it to the action of a variety of reagents, and examining their derivatives. The results coincide with the hypothesis that hippuric acid is benzoyl-amido-acetic acid,  $\text{CH}_2(\text{C}_6\text{H}_5\text{CONH}).\text{COOH}$ . The acid is easily purified by the action of cold dilute  $\text{HNO}_3$ , and the true melting-point is found to be  $187.5^\circ$ , and not  $140^\circ$  as hitherto given. Nitro-hippuric acid—identical with that found in human urine after partaking of nitro-benzoic acid—was obtained

by the action of red fuming nitric acid under pressure, and found to be very stable. Digestion with  $\text{HNO}_3$  changes it into glycol and meta-nitro-benzoic acid. The amide derived from it is likewise decomposed into metanido-benzoic acid, and also changed into oxy-hippuric acid, which yields meta-oxy-benzoic acid and glycol.

Chloroplatinates.—L. F. Nilson.—This name is assigned to the compounds of the metals with the so-called chloroplatinous acid, or  $2\text{HCl.PtCl}_2$ . This is prepared by heating the tetrachloride to  $300^\circ$ , solution in  $\text{HCl}$ , purification in the form of the Ba salt, and separation from the solution of the latter by means of  $\text{H}_2\text{SO}_4$ . The solution of chloroplatinous acid cannot be concentrated without changing the acid from  $(\text{H.Cl.Cl})_2\text{Pt} + x\text{H}_2\text{O}$  into—



a dark brown amorphous powder, easily soluble, and losing at  $100^\circ$  a second molecule of  $\text{HCl}$ . The author has obtained from the solutions of the acid salts with most of the metals, and describes minutely their preparation and properties. They are mostly very soluble and deliquescent. They form handsome large crystals of a dark red colour, and with few exceptions contain water of crystallisation, often in large quantities. The glucinum salt would tend to show that that metal is divalent. The valence of the hexavalent metals is, however, not so sharply marked as in other groups of salts.

Preparation of some Platinum Compounds.—J. Thomsen.—The author has simplified or altered the methods of obtaining the following compounds pure and in large quantities:—Potassium chloroplatinite is prepared by reducing  $\text{K}_2\text{PtCl}_6$  with cuprous chloride. The solution of  $\text{PtCl}_2$  in hydrochloric acid is obtained by adding a concentrated solution of  $\text{PtCl}_4$  in  $\text{HCl}$  to a hot saturated solution of potassium chloroplatinite, the resulting  $\text{K}_2\text{PtCl}_6$  being completely precipitated. The various double salts, the chloroplatinates, are obtained from this solution by the addition of solutions of chlorides. Platinous hydrate is formed by boiling potassium chloroplatinite with exactly enough caustic soda to finish the decomposition, *i.e.*, 2 molecules  $\text{NaOH}$ . Potassium bromoplatinite results from boiling  $\text{K}_2\text{PtCl}_4$  and  $\text{BrNa}$  with a small amount of water. Sodium bromoplatinate is obtained from  $\text{PtCl}_4$  by boiling with 6 molecules  $\text{HBr}$ , adding 2 molecules  $\text{BrNa}$  and evaporation.

Polybasic Acids derived from Phenol and Carbonic Acid.—H. Ost.—By leading  $\text{CO}_2$  over heated sodium phenylate, the author has previously obtained, besides salicylic acid and paroxybenzoic acid, a phenol-dicarboxylic acid, and a phenol-tricarboxylic acid. The former he now prepares in quantities by the action of  $\text{CO}_2$  at  $250^\circ$  on a mixture of sodium and potassium phenylate; and finds by experiment to contain the carboxyl groups of both salicylic acid and paroxybenzoic acid. It is, therefore, ortho-para-phenol-dicarboxylic acid. The tribasic acid is ascertained to be oxytrimesitic acid by eliminating the hydroxyl. It appears impossible, therefore, to replace more than 3 atoms of  $\text{H}$  in phenol by carboxyl groups, those in the meta position being entirely unaffected.

Composition of Leadhillite.—H. Laspeyres.—The analyses of this mineral hitherto accepted are shown to be wrong, leadhillite being identical, crystallographically and chemically, with maxite,  $\text{Pb}_{18}\text{S}_5\text{C}_9\text{O}_{51.5}\text{H}_2\text{O}$ .

Some New Phosphates of Manganese.—H. Laspeyres.—By dissolving Mn compounds met as black oxide or manganates, or permanganates, in syrupy phosphoric acid, and concentrating the solution, four different phosphates are obtained at different stages, all possessing different crystalline properties.

Pyrogallallic Acid.—O. Loew.—In order to study more thoroughly the oxidation of pyrogallallic acid it was enclosed with a small quantity of sodium phosphate and an atmosphere of oxygen in a churn-like apparatus, and submitted to violent agitation. After half an hour considerable  $\text{CO}_2$

had been formed, and the oxidation-products were found to consist of pyrogallo-quinone,  $C_{18}H_{14}O_8$ , and small quantities of two crystalline acids. Concentrated aqueous solutions of pyrogallous acid have a remarkable affinity for other gases, absorbing quantities of NO and cyanogen. The latter produces a white precipitate.

**New Method of Analysing Milk: Presence of a Hydrocarbon in Cow's Milk which differs from Milk-Sugar.**—H. Ritthausen.—The new method is based on the fact that the albuminous bodies in milk are precipitated by cupric oxide not only completely, but without suffering decomposition, and possesses the advantage that all the constituents of milk, with the exception of the water and salts, can be determined in one and the same portion. 10 c.c. are usually used for an analysis, and diluted with 20 volumes of water. 5 c.c. of a solution containing 63.5 grms. of pure crystallised sulphate of copper to the litre are then added, and the solution exactly neutralised with potash. The precipitate settles quickly, the liquid above being perfectly clear. It is then filtered through a weighed filter. The filtrate contains the sugar, which is determined by Fehling's method. The copper precipitate contains not only all the albuminous matter, but also the entire fatty matter, which is extracted by ether, and determined in the usual way. The residue containing the casein is dried over sulphuric acid, then at  $105^\circ$ , weighed, and burnt. The loss of weight is casein. The presence of phosphoric acid, and of the sulphuric acid formed from the casein, prevents the determination of the casein by simply comparing the dried precipitate and the known weight of  $CuO$ . The water and total dried substance are obtained by placing 2 to 3 c.c. of the milk in a weighed crucible containing pure quartz sand, and heating at  $105^\circ$ . The difference between the total dried substance and the sum of the numbers for casein, fat, and sugar gives the amount of salts contained. In the fat separated from the casein in this way, very small quantities of a body resembling milk-sugar were found. Several reactions, especially the inability to reduce oxide of bismuth, show, however, its non-identity.

E. Drechsel describes two new pieces of apparatus for the extraction of soluble matter from solids and the separation of liquids.

**Decomposition of Gelatin and Albumen by Pancreas in the Absence of Air.**—J. Jeameret.—A long series of physiological experiments are detailed, the results of which lead to the following conclusions:—The decomposition of hydrocarbons and of substances containing N by the bacteria in pancreas takes place, not only in the presence of air, but also in its absence, the products being in both cases alike, the latter process, however, requiring much more time. The complete development of the so-called "Kopfchen" bacteria is entirely independent of the presence of air, but requires the presence of bodies containing N. They do not make their appearance in a pure saccharine solution.

**On Leucine.**—M. Nencki.—The author describes more fully a leucine obtained by him in the decomposition of albuminoid gelatin with pancreas, which differs from the ordinary form in being extremely soluble, and possessing a sweet taste.

*Biedermann's Central-Blatt für Agrikultur Chemie,*  
Heft 9, September, 1877.

**Meteorology of Forests.**—A. Johnen and Dr. J. Breitenlohner.—According to these observations both rain-fall and evaporation are less in dense forests with much underwood than where the thicket has been cleared away.

**Examination of the Spring Waters of the Duchy of Meiningen.**—A. v. Lösecke and A. Link.—This paper contains tabulated results of a number of specimens of water. The organic impurities appear to have been merely determined with potassium permanganate.

**Proportion of Potash and Phosphoric Acid in Various Rocks, &c.**—Prof. F. H. Storer.—Already noticed under the *Proceedings of the Bussey Institution*.

**Analysis of Certain Soils.**—Prof. Fr. Farsky.—Among the author's general conclusions it is laid down that the absorptive power for ammonia and phosphoric acid seems to increase with the percentage of ferric oxide and of alumina present.

**Examination of Milk and Butter.**—Chr. Jenssen and L. Block.—The authors have investigated an apparatus devised by Lefeldt for the approximate examination of milk. It is a centrifugal machine which is set in rapid motion for about twenty minutes, and then allowed to come gradually to rest. It is then seen how many degrees of the tube which was originally filled with the sample of milk are occupied by the cream. The results, as compared with those given by the "cremometer" on twenty-four hours' standing appear quite "wild." A sample which, in the cremometer showed 15 per cent of cream, gave scarcely anything in Lefeldt's centrifugal, whilst in others, which showed only 10 to 11 per cent with the cremometer, the centrifugal indicated 6 to 7.

**Determinations of Fat in Milk by Means of Marchand's Lacto-butyrometer.**—F. Schmidt.—An attempt to modify the use of this instrument so as to obtain comparable results.

*Les Mondes, Revue Hebdomadaire des Sciences,*  
Sept. 20, 1877.

In a notice on the destruction of the Colorado beetle, the Paris green is described not as an arsenite of copper but merely as cupric oxide, and is directed to be mixed with ten parts of lime and sifted upon the plants before the dew has evaporated.

Sept. 27, 1877.

This issue contains no original chemical matter.

No. 5, October 4, 1877.

**Study on the Formation of Crystals.**—Karl von Hauer.—This paper treats of the spontaneous decomposition of crystals by the loss of their crystalline water under various circumstances, of which a number of examples are given; of the behaviour of crystals under the influence of light, with especial mention of the formate of cadmium, the cupro-formate of strontia, the aceto-nitrate of strontia, the potassio-oxalate, and ammonio-oxalate of chrome. The author's remarks on the first appearance of crystals amount to little more than an announcement of the fact that more regular crystals are obtained by abandoning solutions to spontaneous evaporation than by allowing a hot solution to cool.

## MISCELLANEOUS.

**Russian Scientific News.**—M. Lentz has published some researches on the electric resistance of solutions of different haloid salts. Solutions containing in equal volumes an equal number of molecules of the salt, and if not too concentrated, yield the following electric resistance:—

KCl..	32.20	NaCl..	40.01	AmCl..	32.29
KT..	31.80	NaT..	42.50	AmT..	31.94
KBr..	30.99	NaBr..	41.27	AmBr..	30.90
KCy..	31.74	—	—	—	—
	31.62		41.26		31.71
ZnCl <sub>2</sub> ..	..	49.95	BaT <sub>2</sub> ..	..	39.45
ZnT <sub>2</sub> ..	..	50.01	BaBr <sub>2</sub>	..	38.57
ZnBr <sub>2</sub>	..	50.18	—	—	—
		50.05			39.01

This table shows that all the haloids of the same element have nearly the same resistance if the same solutions are weak and contain an equal quantity of molecules. Prof. Lentz's opinion is that the resistance of a solution occurs only at the positive ion or cation, and not at the negative.

M. Voronzoff has obtained dipropyloxalic acid  $[C(C_3H_7)_2HO.CO_2H]$ , and is studying its derivatives.

M. Slouginoff has made several experiments on the polarisation of the mercury electrodes during the action of a galvanic current on an aqueous solution of  $Hg_2(NO_3)_2$ . From one to five elements of Poggendorff were used. In this case the polarisation is not constant, and increases with the time to its maximum—

Polarisation of the anode	reaches	0.030	Daniell.
Ditto cathode	„	0.028	„
Ditto anode and cathode	„	0.058	„

The stronger the current the less time is taken to obtain a maximum polarisation. The concentration of the solution has no influence on the polarisation.

Anthracite has lately been found in the Olonetz Government some 200 miles from Petersburg. A person who knows the explorers has informed the writer that the coal may be used for all metallurgical purposes. The coal was tried on board a steamer and gave fair results.

The coal is to be explored and if the mine is workable the price of the mineral fuel in Petersburg may be very cheap. However, we must wait for further information, as Prof. Inostranzeff examined the coal and found it contained 25 to 30 per cent of carbon and about 30 per cent of ash. A small per cent of sulphur was also present. Perhaps the coal examined by the above-mentioned geologist was from the upper layers, and this may be the reason of the inferiority of the mineral. Several mining engineers have been sent to the place.

The war always gives rise to inventions. Mr. Segal has prepared tea preserved with sugar. It is put up in tin boxes of different sizes; a spoonful of the mixture gives, with hot or cold water, a cup of tea. It must be mentioned that such tea can be used only in regions where this "boisson" is unknown, as its taste only faintly reminds one of tea prepared in the ordinary way.

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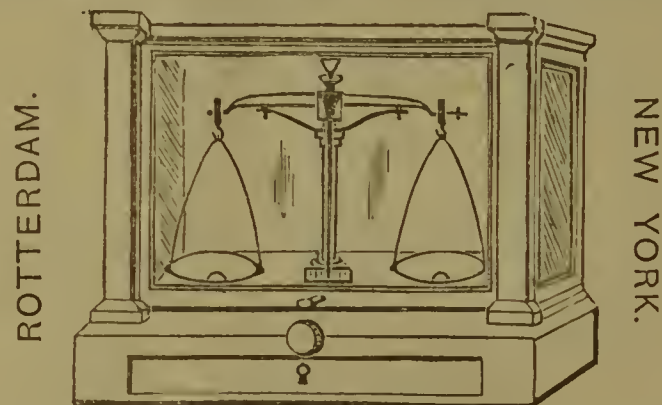
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## THE CHEMICAL NEWS.

Vol. XXXVI. No. 935.

REPORT  
ON THE  
DEVELOPMENT OF THE CHEMICAL ARTS  
DURING THE LAST TEN YEARS.\*By Dr. A. W. HOFMANN.  
(Continued from p. 178.)*Nitric Acid and its Salts.* By Dr. ADOLPH GEYGER, of Berlin.

IV. Methods which infer the quantity of nitric acid present from its oxidising action upon a solution of indigo. Marx† mixes 50 c.c. of the water to be tested with double its volume of pure sulphuric acid, and adds a dilute solution of indigo to the hot liquid until the colour appears green. The effective value of the indigo solution is determined by means of a solution of saltpetre of known strength, the conditions being otherwise exactly alike. Tromsdorff‡ takes only 25 c.c. of water and 50 c.c. of sulphuric acid; determines approximately the quantity of indigo required by a preliminary experiment, adds this quantity at once, and titrates up to the production of a green colour. Goppelsröder,§ Van Bemmelen,|| Finkener,¶ and Fischer,\*\* have proposed various modifications of the method. According to Tiemann's experiments the proportions indicated by Tromsdorf are best adapted for practical execution. The determination of nitric acid by means of indigo always yields, however, inaccurate results if the water under examination contains large proportions of organic matter readily oxidisable. The prejudicial effect of such constituents may be partially, though not completely, removed by previously treating the water with permanganate.

Nitric acid is employed in many branches of industry. The manufacture of coal-tar colours requires nitric acid for the preparation of nitro-benzol, binitro-benzol, and nitro-toluol, from which, as is well known, the various aniline dyes of commerce are elaborated; for the separation of phosphin (chrysanilin) from magenta residues; for the oxidation of anthracen to anthraquinon; for nitrising naphthalin and phenylic alcohol. The conversion of arsenious into arsenic acid is in most establishments effected by means of nitric acid. Large quantities of nitric acid are also employed in the manufacture of sulphuric acid, of nitro-glycerin, of gun-cotton, of silver nitrate, and for the preparation of hare- and rabbit-hairs for the use of hatters.

*On the Practical Utilisation of Nitrous Oxide Gas.* By Dr. OSCAR LIEBREICH, Professor of Medicine in the University of Berlin.

Whilst scientific chemistry in its ceaseless activity produces new substances in rapid succession, and by the charm of this fruitful energy continually acquires creative disciples, we recognise the strange phenomenon that medicine tests in a very deliberate manner these substances, each of which exerts upon the animal economy an influence, even though not invariably capable of useful application. The want of good methods, the exceeding difficulty

of deciding upon the benefit produced, especially since it is necessary in the human subject to contend with great idiosyncracies in different individuals, explain this phenomenon. Thus it occurs that bodies which have long been known to the chemist under various points of view, suddenly acquire an increased signification when their utility has been proved in another department. This occurrence is rarer in technology than in medical science. One of the bodies which have acquired a renewed interest by some practical application is nitrous oxide. No longer a mere laboratory product, it is now, like other medicinal agents, prepared on the large scale.

Nitrous oxide is formed in many reactions. It is a product of the treatment of granulated zinc with nitric acid, or by adding the same acid to a hydrochloric solution of stannous oxide. On the large scale, however, the only method used for obtaining the gas is the application of heat to the nitrate of ammonia. As absolute purity is required for medical purposes, the use of a pure salt is important. The kind obtained by neutralising pure carbonate of ammonia with pure nitric acid should be free from chlorine and from sulphuric acid. The well-known reactions with nitrate of silver and chloride of barium show the purity of the materials to be employed. The development of the gas begins at 170°. The chief art in the manufacture consists in the regulation of the heat, which must be moderated when the liberation of the gas commences. If the charge is overheated nitrogen and ammonia are formed, as well as nitric oxide, the most dangerous by-product if inhaled. Even the gas obtained from pure materials, and with the utmost care, requires purification, which is best effected by a passage through a set of washing-bottles, charged with sulphate of iron, potassalys, and milk of lime. Any nitric oxide formed is destroyed by the sulphate of iron, acids are retained by the potash and carbonic acid; the least dangerous impurity is further absorbed by the milk of lime.

The organs of dentistry describe minutely the apparatus required, which possesses for chemists no novelty, since it is the same which has been employed in laboratories for the preparation and purification of the gas. In most cases dentists prepare the gas for themselves, but in Berlin an apothecary, Herr Worf, occupies himself with filling gasometers for dentists.

The compression of the gas for sale must be mentioned as a new and interesting feature. This practice was first carried out in London according to Evans's process. The gas used for compression is prepared as above described, and received in iron bottles (about 40 centimetres long by 15 wide) provided with a strong screw-valve. The largest quantities are prepared in London by the mechanic, J. Orchard, jun., of Kensington, and Messrs. James Coxeter and Son, of Grafton Street, through whose hands the cylinders are supplied, have had the kindness to communicate certain figures showing the enormous amount of the consumption. There were sold in—

1871	.. .. .	146,211 gallons.
1872	.. .. .	214,478 "
1873	.. .. .	202,252 "

The decrease in the year 1873 is explained by a death during narcosis (*British Journal of Dental Science*, Feb., 1873).

The rapid circulation of this calamity through the press discouraged the public. Whilst in January, 1873, 23,000 gallons were sent out; the sale in the month of February, when this misfortune occurred, fell to 10,900, but it has subsequently increased again in an intensified proportion. In Germany the compressed gas has been introduced by the well-known firm, Ash and Son, of Broad Street, London. No special establishments for the manufacture of the Gas in Germany.

After the discovery of nitrous oxide by Priestley in 1776 it was more closely examined in 1809 by Davy,\* and its

\* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

† Marx, *Zeit. für Anal. Chem.*, 1868, p. 412.

‡ Tromsdorf, *Ibid.*, 1870, 171.

§ Goppelsröder, *Ibid.*, 1870, 1.

|| Van Bemmelen, *Ibid.*, 1872, 136.

¶ Rose, *Anal. Chemie*, ii., 831.

\*\* Fischer, *Journ. f. Prakt. Chemie*, 1873, 57.

\* Chemische und Physiol. Unters. über das oxydirte Stickgas u. das Attimen in demselben, von Humphry Davy. Aus d. Eng., 1812-1814.

essential properties determined; the compression of the gas to a liquid was, however, first effected by Faraday. Davy observed that the gas if respired produced in man a peculiar condition, and this experiment has since been often repeated with confirmatory results. A peculiar excitement appears; the senses disappear at the first inhalations, and a singular drumming is felt in the ears. The body experiences a peculiar sensation of comfort, and the observer recognises the symptoms of merriment. The name of laughing-gas was therefore given to the gas by Davy on account of these properties, although in certain rare cases the excitement may pass over from cheerfulness to the opposite state of sadness. On continued respiration complete unconsciousness occurs, and finally death. This power of the gas to produce unconsciousness, discovered by Davy, was not practically utilised till later. In 1844, two years before the introduction of chloroform by Simpson Horace Wells, a practical dentist applied nitrous oxide to himself, the narcosis being conducted by the chemist Dr. Colton. The new process, however, did not come into extended use prior to 1863. Narcosis for the extraction of teeth was often resorted to by dentists under Colton's superintendence, and in 1867 it came to the knowledge of the celebrated dentist, Evans, of Paris. From this time the scientific utilisation of the method must be dated. On March 31, 1868, the gas was tried by Evans on several patients in the Dental Hospital of London, and by the donation of £100 means were provided for testing the merits and defects of the process. The first report\* on its results for dental purposes was very satisfactory, especially as regards a large number of cases conducted by Woodhouse Braine.† The gas now came into increasing use also on the Continent.

Various apparatus were required to facilitate the inhalation of the gas. There are simple mouthpieces through which the gas streams, and there are more complicated ones which permit the simultaneous entrance of air. There are also gasometers of special construction for receiving the needful quantity of gas. A large selection of such contrivances may be seen in the establishment of Messrs. Ash and Son.

As regards the application of the gas, it has been ascertained with certainty that the narcosis thus produced can be used only in such cases as require a short insensibility to pain. For dental operations the gas is therefore peculiarly suited. For more extensive operations in the cavity of the mouth it is less to be recommended. With skilful management it is possible greatly to reduce the stage of excitement or to get at once beyond it. A great advantage as compared with other anæsthetics is that a tendency to vomit scarcely ever appears at the first inhalation. The action of the heart is scarcely affected, and after the re-admission of air the insensibility of the patient quickly disappears, and the general condition of the system is entirely normal. Attempts have been made to operate with mixtures of nitrous oxide and other narcotics. Thus C. Sauer (*Vierteljahrs f. Zahnheilkunde*, iv. Heft, 1869) has experimented with nitrous oxide and chloroform. An instructive treatise on the use of nitrous oxide gas alone for dentists has been published by Dr. C. Grohnwald.‡

Although the practical application of this agent has been found useful, we have but few and insufficient facts towards a scientific explanation of its action. It seems that nitrous oxide does not give up its oxygen for combustion, and does not enter into chemical combination with the red blood-globules, since, as Nawrocki has shown, its absorptive relations for blood and for water are almost identical. On respiration dyspnoea and asphyxia are produced just as on the inhalation of other indifferent gases, but the sense of

suffocation is masked by the peculiarity of the intoxication. We must content ourselves with seeking the explanation of the action of the gas in the fact that it suppresses the function of the ganglionic apparatus of the brain. Direct action upon the nervous organs of the heart has not been traced. Slight as are these scientific data, they yield valuable indications for its application, which correspond with practical experience. In the first place, the gas must not be inhaled for a long time consecutively; secondly, it is advantageous to mix with it at least one-tenth volume of atmospheric air; the longer the narcosis is required the more air must be admitted, though the proportion must not exceed quarter volume. Especial attention must be paid to the respiration of the patient. That even with this method of inhalation unfortunate results occur need not surprise us, since from incidents not hitherto explained the use of almost every anæsthetic has demanded its victims. The statistical numbers published testify for its relative safety.

It cannot, however, be denied that the complication of the arrangements required for inhalation is an inducement to seek for new agents suitable for the purposes of dentistry. Thus the author has successfully applied, both in short and in protracted operations, ethylidene-chloride, which, according to Hofmann, is abundantly formed as a by-product of the formation of chloral from alcohol. It has also been found suitable for dental operations by C. Sauer, of Berlin, in a long series of experiments.

(To be continued.)

## ON THE ANALYSIS AND VALUATION OF SPENT OXIDES OF IRON FROM GAS WORKS.

By GEORGE E. DAVIS.

IN the CHEMICAL NEWS, vol. xxix., p. 30, I pointed out that there were sometimes present in spent oxides substances generally disregarded, but which played a very important part in the vitriol manufacture. Lime, or carbonate of lime, when present, abstracts or retains an equivalent of sulphur in burning the spent oxide, so that the amount now usually given on the assay note as available sulphur is not always available, and the consumer is called upon to pay for that which it is impossible for him to burn out. At and before the time the above paper was written it was usual in many cases to estimate the sulphur by oxidation of all sulphur present, and collecting the sulphuric acid by precipitation with a soluble barium salt, and then to estimate the sulphur present as sulphates by precipitation without oxidation, the difference between the two giving what was reported as "available sulphur." Then came the "bisulphide method," which consisted in dissolving out the sulphur with bisulphide of carbon, distilling off the bisulphide, and fusing the residual sulphurs. This method would give fairly accurate results were it not that tarry matters dissolve out also which are difficult to eliminate by any after operation without danger of losing sulphur.

This method was in use in my laboratory for some time, but experience showed that the results of the experiments did not show the real amount of available sulphur, there being at least two errors—first, the tarry matters dissolving out in the bisulphide of carbon used; and, secondly, if any carbonate of lime was present, its presence made no difference in the results of the analysis. It would certainly be possible to make a mixture of lime, or carbonate of lime, and spent oxide in such proportions that none, or but very little, sulphurous acid would be evolved on combustion; yet such a mixture would give abundance of sulphur—stated to be available—when examined by the bisulphide method. It is well known that in most gas

\* First Report by the Joint Committee of the Odontological Society of Great Britain, and the Committee of Management of the Dental Hospital of London, to enquire into the value and advantage of the protoxide of nitrogen as an anæsthetic in surgical operations. *Trans. Odont. Soc. of Great Britain*, i., No. 2.

† Braine, *loc. cit.*, No. 7.

‡ Grohnwald, "Stickstoffoxydulgas als Anæstheticum." Berlin: 1871.

works lime is used in the purifiers, even where oxide of iron is used, and the lime and oxide being often placed in close proximity to each other for want of room, it is not very wonderful that the spent oxides should often contain carbonate of lime. In some cases lime is purposely added to the purifying material and it is certainly surprising that manufacturers agree to pay for what sulphur it is impossible to burn off, and also for tarry matters, which they are aware will not make oil of vitriol.

Sometimes the sulphur obtained from the assay of the spent oxide by the bisulphide method is remarkably pure, at other times it is very impure and cannot be properly purified without loss of sulphur. As instances the following figures are given, which show the amount per cent of pure sulphur in six different samples of the above—sulphurs weighed by another chemist, who, at my request, saved them for me from his work.

No.	A.	B.
1	90.41	90.19
2	97.60	97.52
3	97.38	97.44
4	92.66	92.74
5	98.92	98.88
6	99.84	99.93

In A the sulphur was ground up with a mixture of carbonate of soda and nitrate of soda, and projected into fused nitrate of soda in a porcelain crucible, the sulphuric acid being precipitated in the ordinary way as barium sulphate. In B the sulphur was dissolved by boiling with pure sodium hydrate, and a current of chlorine passed into the solution until the oxidation was complete; the sulphuric acid so formed was treated as in A.

The bisulphide method proving so unsatisfactory, I began to look around me for an accurate method—for one which would give the real amount of available sulphur—or that amount which would be liberated by the thorough combustion of the oxide under the varying circumstances, lime or no lime, tarry matters and other oxidising substances. With this end in view it was thought necessary to thoroughly examine all the spent oxides which are to be met with in commerce, to know once for all how the various constituents were likely to behave towards the reagents to be used, and under the physical conditions to which they were to be subjected.

The spent oxides of commerce may be divided into three classes.

1. Those formed when precipitated oxides of iron are used.
2. Those formed when natural hydrated oxides of iron are used, such as bog-ochre, &c.
3. Those produced from copperas or dry copperas.

As instances of the first class may be cited the following analyses:—

	I.	II.	III.
Ferric hydrate .. .. .	18.42	17.74	19.36
Sawdust .. .. .	2.42	1.98	4.72
Carbonate of lime .. .. .	none	none	1.04
Ammonium sulphocyanide ..	2.52	1.99	2.74
„ ferrocyanide .. .. .	traces	traces	traces
Tarry matters .. .. .	0.72	0.84	1.22
Sulphur .. .. .	67.18	66.22	62.44
Matters insoluble in dilute HCl	3.66	5.47	3.76
Moisture (by difference) 1..	5.08	5.76	4.72
	100.00	100.00	100.00

The spent oxides of the second class being produced from oxides of iron not in such a fine state of division as the first class, generally contain more ferric hydrate and less sulphur; the difference in oxide, however, does not alter the accidental constituents, such as sulphocyanide and tarry matters.

The following analyses will show the composition of oxides of the second class:—

	IV.	V.	VI.
Ferric hydrate .. .. .	26.42	25.91	15.96
Sawdust .. .. .	1.24	1.14	3.72
Carbonate of lime .. .. .	none	1.73	0.46
Ammonium sulphocyanide ..	1.93	1.87	0.94
„ ferrocyanide .. .. .	0.21	trace	trace
Tarry matters .. .. .	1.14	0.96	0.92
Sulphur .. .. .	50.42	48.76	57.44
Insoluble matters in dilute HCl	11.42	11.42	9.74
Prussian blue .. .. .	trace	0.17	trace
Moisture (by diff.) .. .. .	7.22	8.04	10.82
	100.00	100.00	100.00

Examples of oxides of the third class may be seen in the following analyses:—

	VII.	VIII.	IX.
Ferric hydrate .. .. .	5.04	7.23	6.84
Sawdust .. .. .	1.89	3.24	1.04
Carbonate of lime .. .. .	none	none	1.11
Ammonium sulphocyanide ..	2.52	3.41	1.98
„ ferrocyanide .. .. .	0.64	0.27	0.33
Tarry matters .. .. .	1.18	0.72	0.43
Sulphur .. .. .	55.74	48.76	52.46
Insoluble matters in dilute HCl	7.82	10.65	12.68
Calcium sulphate .. .. .	1.43	trace	0.72
Ammonium sulphate .. .. .	12.78	16.72	15.54
Prussian blue .. .. .	1.74	0.22	trace
Moisture (by diff.) .. .. .	9.22	8.78	7.98
	100.00	100.00	100.00

The foregoing analyses represent very fairly most of the spent oxides found in commerce; occasionally very bad ones are found, containing very large quantities of carbonate of lime or sawdust, or happen to contain very little sulphur or large quantities of moisture. The following three analyses are of samples of bad oxides:—

	X.	XI.	XII.
Ferric hydrate .. .. .	20.40	8.72	10.99
Sawdust .. .. .	2.16	9.76	3.18
Carbonate of lime .. .. .	10.36	5.87	none
Ammonium sulphocyanide ..	4.72	0.76	1.18
„ ferrocyanide .. .. .	traces	0.34	0.44
Tarry matters .. .. .	0.67	1.04	0.55
Sulphur .. .. .	32.42	42.16	36.78
Insoluble matters .. .. .	16.76	20.71	12.12
Calcium sulphate .. .. .	3.23	1.77	none
Ammonium „ .. .. .	none	0.74	1.14
Prussian blue .. .. .	traces	0.64	0.21
Moisture (by diff.) .. .. .	9.28	7.49	33.41
	100.00	100.00	100.00

Having the results of many analyses like the foregoing twelve in view, and after many trials and experiments, the only correct method of estimating the *available* sulphur, which could be done in a short space of time, was to make a combustion of the sulphur, thus imitating the operations of the manufacturer.

The advantages of a combustion method are self-evident, tarry matters are burnt into carbonic acid, and any carbonate of lime present retains its equivalent of sulphur, which equivalent would not appear in the report of the analysis.

There were several difficulties to overcome before the combustion method was perfected, and as the process now stands and is about to be described—in the absence of carbonate of lime and tarry matters—gives results which are practically identical with the bisulphide method.

The process has been in use in my laboratory for over six months, during which time over two hundred samples of spent oxides have been examined by it. The results have been perfectly satisfactory, therefore the bisulphide method has been discarded as not always trustworthy, because it does not always give the true amount of *available* sulphur, which the combustion process does.

In experimenting upon the process it was at first surmised that the tarry matters, sawdust, and cyanogen compounds would interfere with any process which depended upon the volumetric reduction of standard solutions, and as the first samples operated upon contained no sulphate of ammonia the unwashed sample was burnt, and the sulphur dioxide passed into diluted peroxide of hydrogen, the sulphuric acid so formed being weighed as sulphate of barium.

This was found too long and tedious a process, and the cost of peroxide of hydrogen was great; so, after numerous trials and experiments, the gravimetric process was abandoned for a volumetric one.

It would swell this paper to an unnecessary length to enter into the details of all the trials and failures performed and obtained upon this subject, therefore I will proceed to describe the combustion process at length, exactly as it is now carried out in my laboratory.

Generally the report of the analysis includes the quantities per cent of moisture, sulphate of ammonia, and sulphur. With the two first it is unnecessary to describe their estimation, only so far as it relates to this process.

5 grms. of the oxide for analysis are weighed off and dried at 100° C. till it ceases to lose weight, which generally takes about two hours. After weighing, the dried sample is transferred to a beaker and digested with hot water, then washed on to a tared filter, and thoroughly washed with water.

The filter is then placed in the drying oven until it ceases to lose weight at 100° C. When thoroughly dried it is weighed again, the weight noted, and the filtrate is used for the estimation of the ammonia, which is calculated as sulphate, though it will be seen by the analyses of the foregoing oxides that the ammonia is often combined with several other acids, and that often no sulphate of ammonia is present. The washed and dried residue is then finely ground up in a mortar, and 0.16 gm. is weighed off into a porcelain boat in a thin layer about 2 inches long, when it is ready to be placed in the combustion-tube, which has been heated to low redness for its reception.

The furnace used may be of any form—that used in my laboratory is Glaser's pattern, and the combustion-tube of very infusible potash glass lies in a packing of asbestos. The tube projects about 2 inches from each end of the furnace; one end is left open and the other is fitted with a good cork, through which passes a glass tube. Connected with this tube by a very short piece of india-rubber tubing free from sulphur is a bottle fitted with a caoutchouc stopper holding two tubes, one penetrating just below the stopper and the other reaching nearly to the bottom of the bottle. When the furnace has been heated sufficiently 60 c.c. of decinormal iodine solution are placed in the bottle and well diluted with water. The short tube of the bottle is then connected with the Bunsen pump, and a steady current of air drawn through the tube. The boat containing the oxide is now pushed gradually and cautiously into the tube, so that the sulphur burns slowly from the front to the back of the boat. When the flame of the sulphur has all disappeared the boat is pushed into the full red portion of the tube, and left in the current of air for about three minutes. At the end of this time the boat is withdrawn and the contents of the bottle titrated with decinormal sodium hyposulphite, when, if 0.16 gm. has been taken, each c.c. of iodine solution reduced will give the percentage of sulphur direct.

The above is the number of parts of sulphur in 100 of the residue, freed from moisture and all soluble constituents; a calculation is therefore necessary to know what the percentage would be upon the original sample in its unwashed and undried state.

In order to better describe the process the following is given, made upon a sample of good oxide, exceptionally free from tarry matters and free also from any bases likely

to retain sulphur, and which, when examined by the bisulphide of carbon method, gave the following results:—

	Wet.	Dry.
Moisture .. .. .	6.60	—
Sulphate of ammonia.. ..	18.30	19.60
Sulphur .. .. .	42.70	45.70

5 grms. dried at 100° C. weighed 4.67 grms., which is equivalent to 6.6 per cent moisture.

The 4.67 grms. were then digested with water and washed on to a tared filter till free from ammonia. The filtrate when boiled with soda gave off ammonia sufficient to neutralise 13.9 c.c. of normal acid, or equal to 18.35 per cent of sulphate of ammonia in the wet sample. The washed and dried residue weighed 3.722 grms., and 0.16 gm. of this residue when burned in the combustion-tube gave off sulphur dioxide, which decolourised 57.1 c.c. of decinormal iodine.

From the foregoing experiments it will readily be seen that the 100 parts of the oxide experimented upon were made up as follows:—

Water .. .. .	6.60	(a)
Soluble matters .. ..	18.96	(β)
Insoluble .. .. .	74.44	(γ)
	100.00	

Sulphur in 100 parts of the "insoluble" .. 57.1 = δ

The percentage of sulphur in the moist original sample (x) is found from the formula (1).

$$(1) \quad x = \frac{y \times \delta}{100}$$

and the sulphur on the dry sample from (2).

$$(2) \quad \frac{x \times 100}{\beta + \gamma}$$

Formula (1) gives:—

$$\frac{74.44 \times 57.10}{100} = 42.5$$

and formula (2)—

$$\frac{42.5 \times 100}{18.96 + 74.44} = 45.5$$

The two processes have given from the same sample of oxide the following results:—

	Bisulphide Method.	Combustion Method.
Moisture .. .. .	6.60	6.60
Sulphate of ammonia (wet)	18.30	18.35
" " (dry)	19.60	19.64
Sulphur (wet) .. .. .	42.70	42.50
" (dry) .. .. .	45.70	45.50

The following results were obtained from spent oxides examined from time to time, and in every instance where the bisulphide method gave higher results than the combustion method, it was fully proved that there was no error in the latter, but that there was present either much tarry matter or bases which retained sulphur in combustion:—

	I.	II.	III.	IV.
A .. ..	48.34	45.31	45.46	45.28
B .. ..	52.76	51.50	51.70	51.58
C .. ..	58.84	58.60	58.76	58.81
D .. ..	42.96	41.70	41.70	41.90
E .. ..	48.46	48.29	48.33	48.14
F .. ..	49.87	49.04	49.11	48.98
G .. ..	62.38	60.12	59.96	60.22
H .. ..	54.77	51.71	51.50	51.60

The numbers in column I. are by bisulphide of carbon; in columns II. and III. are numbers obtained by the combustion method as before described; and in column IV. numbers obtained by the combustion of sulphur; but the sulphur dioxide was passed into hydroxyl, and the sulphuric acid weighed as barium sulphate.

It has often been said that the anhydrous oxide of iron will not take up sulphur from coal-gas; to show that this notion is erroneous is given an analysis of spent oxide produced by mixing burnt pyrites after the extraction of the copper with sawdust, and placing in the purifiers in the usual way. The oxide had been in use in a small gas works for nearly twelve months:—

Ferric hydrate .. .. .	6.28
Ammonium sulphocyanide.. ..	1.56
„ chloride .. .. .	0.72
Tarry matters .. .. .	1.00
Moisture .. .. .	16.40
Insoluble in dilute HCl .. ..	35.50
Sulphur .. .. .	34.00
Sawdust &c. (by diff.).. ..	4.54

100.00

In conclusion I may add that the sulphur must be determined if by this combustion method in the *washed* and *dried* sample; the raw original sample must on no account be used, for when the raw sample is operated upon no two results can be made to agree, for in the first place there are present sulphates, sulphocyanides, and ferrocyanides, which are acted upon in different manners as the air current is more or less rapid, and the heat of the combustion-tube more or less intense. The sulphate of ammonia may be split up and form sulphur dioxide, or it may be simply volatilised, or both conditions may coexist and incorrect results will be obtained. Neither is it of any use to aspirate the products of combustion through a solution of carbonate or caustic soda, titrating afterwards the sulphur dioxide with decinormal iodine, for more than 30 per cent is by this means oxidised to sulphuric acid, and though this may be precipitated and weighed as barium sulphate, yet this is a much longer method, more tedious, and not more accurate, so that for all technical purposes where the amount of *available* sulphur is required, the only process at once rapid, easy, and accurate is the method of combustion as given above, burning the sulphur into sulphur dioxide, absorbing this in decinormal iodine largely diluted with water, and titrating the excess of iodine solution with decinormal hyposulphite.

Barton Arcade, Manchester,  
October 9, 1877.

## ON THE EXISTENCE OF A CONNECTION BETWEEN ELECTRICITY AND THE MOTIONS OF CAMPHOR ON WATER.\*

By P. CASAMAJOR.

You are doubtless familiar with the singular motions of camphor when placed on the surface of water, which are of such extraordinary nature as to attract the attention of even the most careless observer. Very eminent philosophers have studied these wonderful gyrations, but little has resulted from their labours to explain the cause of this phenomenon. Among those who have worked on the subject we find the great Volta; we also find Venturi, Brugnatelli, Fourcroy, Biot, Matteucci, and Dutrochet. Mr. Charles Tomlinson, who has given great attention to the subject, published in 1863 a work,† in which he gave a full account of previous labours of eminent physicists and chemists on these motions of camphor, to which he added many interesting experiments of his own. I cannot do better than advise those who wish to study the history of the subject to consult this excellent book.

\* Read before the American Chemical Society, October 4, 1877.

† "Experimental Essays. I. On the Motions of Camphor on the Surface of Water." By Charles Tomlinson. Virtue, Brothers, and Co. London: 1863.

I find in this work that in 1748 Romieu communicated to the Royal Society of Montpellier his observations on camphor, in which he advanced the idea that electricity is the cause of these singular motions. Romieu states that camphor does not rotate on the surface of water placed in vessels of iron or copper, but the experiment succeeds very well in those made of glass, sulphur, or resin. He also states that while camphor is spinning in these vessels it is arrested if the surface is touched with the finger, with iron or brass wire, or a rod of wood; but glass, sealing-wax, or sulphur cannot arrest these motions.

This idea that the motions of camphor on water are due to electricity has met with the disapprobation of all subsequent observers, among whom may be found the names of men who are famous in the history of electricity. Notable among these is Alessandro Volta, who made several experiments to show that electricity had nothing to do with these motions.

Now, I propose to show you this evening that there is an evident connection between electricity and these motions of camphor, and, as Volta and other eminent philosophers are unanimous in asserting that there is no such connection, I may be allowed to say that in the experimental sciences there is no authority of as much value as a fact, if the fact has been well observed. I propose, therefore, to show you the facts, and you are to be the observers. These facts naturally lead to the conclusion that the remarkable motions presented by camphor on the surface of water are electrical phenomena. I am not prepared at present to go beyond presenting these facts, and drawing from them what seems an evitable conclusion. The phenomena which accompany these motions of camphor are very complex, and they have stubbornly resisted every attempt on my part to bring them under a general theory. I am in the hope, however, that what I have to present this evening may serve to elucidate this interesting subject.

Camphor is not the only substance which moves spontaneously on the surface of water. Volta discovered the same property in benzoic and succinic acids. Others have added the stearoptenes of essential oils, the butyrates of soda and potassa, carbolic acid, and citric acid;\* even pieces of cork soaked in ether will exhibit the same phenomenon for a short time. Naphthalen is mentioned in some books as possessing the same property, but I have found that it has not. These substances, with the exception of the stearoptenes, are heavier than water, and they are with difficulty kept afloat: they are also more soluble than is quite convenient for the experimenter. As they behave exactly in the same manner as camphor towards electricity, I will confine my remarks to camphor, as I have almost entirely confined my experiments to this substance.

If we throw pieces of camphor in water they rise to the surface, and, if the conditions are favourable, they will move on the water as if gifted with life. The larger fragments have slower motions than the smaller, which is due to their greater inertia, for if we sprinkle the surface of the water with lycopodium, after the ingenious idea of Mr. Tomlinson, we will find that the currents that set from the larger pieces are stronger than from the smaller. The mobility of the liquid being greater than that of the larger pieces the liquid moves away from the camphor. The shapes of the fragments of camphor have a great influence on the rapidity of their motions. A spherical piece will exhibit very little motion, while an elongated piece of the same volume, terminated by two pointed pyramids,† will rotate with the greatest energy.

Very often the conditions under which the motions take place do not exist, and camphor remains perfectly quiet on the surface of the water. It has generally been supposed that when this happened the surface of the water

\* Hence, as suggested by Tomlinson, a quick way of distinguishing citric from tartaric acid, which does not possess this property.

† As camphor breaks up very readily while being cut, I have agglomerated it into cylinders by compressing it in a Plattner's ore crusher. Thus compressed it stands handling much better.

was covered with a film of dirt—either oil, dust, or something else—which, for some reason, prevented the gyration from taking place. If, however, we keep the same water in a glass for several days, and place in it at different times fragments of the same pieces of camphor we will sometimes have motions, and at other times not, which points to the conclusion that these irregularities are independent of the camphor, of the cleanliness of the water surface, and of the vessel that holds the water.

In the daytime the motions are more apt to take place than after sundown. Also when the weather is bright, or when it storms, than when the sky is cloudy and the air damp, but without any presages of a storm. In many books we find that these motions of camphor on water are due to evaporation, although some add the truthful remark that this explanation is not satisfactory. When I began these researches I tried several times to determine these motions by heating the water, but without success; while at other times the camphor spun in a lively manner on the surface of ice-water. Evaporation was clearly not the cause.

At this stage of the matter a gentleman, who is one of our Associates, communicated to me an observation, which I have already mentioned, that if fragments of the same piece of camphor are placed on several successive days in the same volume of water, sometimes there is motion and sometimes not. It was suggested at the same time that perhaps magnetism or electricity had something to do with it.

Rejecting magnetism as improbable, and not being aware at the time of the disapprobation by eminent philosophers of the existence of any connection between the motions of camphor and electricity, I made the following experiments, which I propose to repeat before you after reading this paper.

Having before me a beaker-glass holding water, on the surface of which small fragments of camphor were dancing with great energy, I rubbed a clean glass rod with flannel, and dipped the rod in the water, when I was surprised to see all the small pieces of camphor suddenly reduced to immobility. This experiment was repeated several times with fresh portions of water and of camphor, and always with the same result. Subsequently, the same glass stirrer, rubbed with tin-foil to render it electrically neutral, failed to produce any effect.

In the next place, the same experiment was tried with a piece of vulcanite previously rubbed with flannel, but the motion of the camphor did not stop, and they even appeared to increase in intensity. To test whether this was the case, I was led to stop the motions with a glass rod, and then touch the water with the excited vulcanite. You may judge of my pleasure when the fragments of camphor began again their gyrations as the vulcanite touched the water. I afterwards ascertained that a rod of shellac or of sulphur, had the same effect as one of vulcanite.

The first deduction I made from this was that positive electricity stops these motions of camphor, while negative electricity increases their intensity. This deduction, however, was erroneous, as I subsequently found that if, after the motions are stopped by an excited glass rod, it is taken out, wiped dry, and excited again, and dipped in the water; and if the same operation is repeatedly gone over, the motions recommence, and increase in intensity every time the excited glass rod is placed in the water. I also found that motions due to positive electricity may in their turn be stopped by dipping in the water an excited rod of vulcanite.

This requires a word of caution, as by rubbing glass very little positive electricity is obtained, when compared to the negative electricity which may be had, in the same manner and in the same time, from vulcanite, shellac, or sulphur. This difference requires that a negatively electrified rod be used with great nicety, as otherwise we bring in contact with the water more negative fluid than is necessary to neutralise the positive electricity, and, as a consequence, the water becomes at once negatively

electrified, and the motions continue without interruption.

When the passage from one kind of electricity to another is very gradual there always occurs an intermediate stage at which, if several pieces of camphor are on the water, they coalesce. Afterwards, when the water becomes more decidedly electric, these pieces part company, sometimes in quite a violent manner. A point of great importance to note is that when the surface of the water is electrically neutral, and pieces of camphor adhere to one another, they remain for a long time without perceptibly diminishing, while when they are in active motion they wear away in a much shorter time.

Gentlemen, I do not feel that I sin against any rule of the strictest logic when I conclude from the facts which I have mentioned that there is a connection between electricity and these motions of camphor. As to the cause of these motions, it resides in the camphor itself, and the explanation of the phenomenon must be found in some property possessed by certain substances, of which camphor is the type, by virtue of which water which has been electrified dissolves them with greater rapidity than when not electrified. If a piece of camphor is held fast on the surface of the water, and lycopodium is sprinkled over this surface, as was done by Mr. Tomlinson, we will see currents flowing outwardly from the camphor. This may be explained by supposing that the water, holding camphor in solution, has the same electricity as the camphor itself. If the fragments are very small and are free, their great mobility allows them in their turn to be repulsed by the surface of the water, which remains comparatively stationary. When we hold fast on the surface of water a piece of camphor with an irregular outline we may see, by means of lycopodium, that the currents flowing outwardly from the camphor are very uneven in different directions. The inequality of the currents must, when the camphor is set free, determine its motion in a direction opposite to the resultant of these currents.

The enquiry which now presents itself relates to the nature of the remarkable property which enables some organic substances—such as camphor, benzoic acid, and others which I have mentioned—to move on the surface of water when it is electrified. Dutrochet ascribed these motions to a new force, which he called the *epipolic* force. This amounted to giving up the problem. For my part, although I have endeavoured to discover the nature of this property, the results which I have obtained are as yet too meagre and too contradictory for presentation before this Society. I do not despair, however, at some future day to present you with results worthy of your attention.

**Liebig Memorial.**—Immediately after the death of Liebig, at the suggestion of the German Chemical Society, an International Committee was formed for the purpose of preserving to future generations in a visible form the memory of the great investigator. This Committee has now so far advanced in its preparations as to be able to proceed to the accomplishment of this important task. For this object an Executive Commission has been entrusted by the International Committee with the necessary powers. Accordingly all sculptors are invited to participate in a general competition. The monument is to be erected in the Maximiliansplatz in Munich, which is laid out as a garden. The sum of 120,000 marks is allotted to the erection of a bronze statue upon a richly decorated pedestal, for the artistic adornment of which Liebig's varied activity affords most appropriate materials. The Executive Commission offers for the best of the models sent in a prize of 2000 marks, for the second a prize of 1500 marks. The competitors are requested to choose such a scale for their models that the figure, considered as standing upright, should be 40 centimetres in height. The models, which will be publicly exhibited first in Berlin and then in Munich, must be sent in between the 1st and 15th of June, 1878, addressed to Kastellan der Königl. Akademie der Künste, 38, Unter den Linden, Berlin.

## PROFESSIONAL ORGANISATION OF CHEMISTS.

THE long correspondence which appeared in our columns on the necessity of an organisation among chemists, similar to those existing in other professions, will still be fresh in the memory of our readers. We have at last the pleasure of announcing that, after long and anxious deliberation, definite steps are about to be taken towards the desired end. That the scheme selected is beyond the reach of criticism its promoters do not pretend, but to their best belief it is, if not the best conceivable, at all events the best practicable. Perhaps, theoretically speaking, the orthodox procedure would have been to have called a general meeting of the whole profession to have laid down certain main principles, and committed their elaboration to a council then and there elected. But there is every reason to fear that such a meeting would have been obliged to separate *re infecta*. In consequence a very different plan has been pursued. A number of chemists—including some who are generally recognised as among the heads of the profession—have associated themselves under the title “The Institute of Chemistry of Great Britain and Ireland.” This Association will be enrolled under the “Companies Act” of 1867, but will be debarred by one of its articles from paying, directly or indirectly, any dividend or bonus to any of its members. The Association is to consist for the present of 500 members, who alone are qualified to vote at its general meetings and to exercise any share in its administration. The ordinary government of the Institute is vested in a Council, consisting of a President, six Vice-Presidents, a Treasurer, and twenty-seven Ordinary Members. These offices are already filled, and the present Council is to continue in office “until the first General Meeting, which shall be held after the end of the second year after the Registration,” and will consequently have in their hands the power of organising the Institute and launching it on its career.

Besides Members, the Institute will comprise Fellows and Associates. It is remarked that “No one shall be a Member of the Association unless he be a Fellow thereof, but the Council may admit persons to be Fellows who are not Members; such Fellows, nevertheless, shall have none of the rights of Members.”

For the first six months after the registration of the Association the Council may admit Fellows and Associates, either as Members or non-Members, upon such evidence of fitness as the Council may deem sufficient, or without any such evidence, at their discretion. After the said first six months, and during the then succeeding thirty calendar months, the Council shall require from any candidate for a Fellowship the following evidence of qualification:—“That he is not less than twenty-four years of age; that he has passed through a course of three years’ training to the satisfaction of the Council in Theoretical and Analytical Chemistry and Physics, and has subsequently been engaged for three years either as Assistant to a Chemist of repute or as a Professor or Demonstrator of Practical Chemistry at some known University, College, or Medical School, or as a Chemist in a technical industry; or has, after three years’ training as above, conducted and published an original research of sufficient merit, in the opinion of the Council, on some chemical subject requiring practical work. Or that he has been trained and occupied in other ways which, in the opinion of the Council, are equivalent to fulfilling the conditions stated in the preceding article.”

The document then becomes somewhat obscure. A second set of qualifications for Fellows succeed, which may possibly apply to such persons as apply for Fellowships after the six and the thirty months have elapsed. Such persons, if we understand rightly, are to show that they are not less than twenty-four years of age; that they

have been admitted to the Institute as Associates, and have since been engaged for three years in the study and practice of Applied Chemistry in a manner satisfactory to the Council.

What are to be the qualifications of Associates who apply for admission during the first six months does not distinctly appear. After the first six months, and during the succeeding thirty months, such persons will be required to show that they are not less than twenty-one years of age; and have passed a course of three years’ study of Theoretical and Analytical Chemistry, Physics, and Elementary Mathematics, satisfactorily to the Council. After the thirty months candidates for Associateship will have to show that they have been trained and educated “in such a manner as the Council may from time to time direct, and, in addition, must have passed an examination approved by the Council in Chemistry, Physics, and Elementary Mathematics, conducted by a recognised University, College, School, or Society, or has passed such other examination as shall have been prescribed by the Council.” Every Fellow is to pay an entrance-fee of five guineas and an annual subscription of two guineas. Every Associate shall pay an annual subscription of one guinea. Both Fellows and Associates on admission will be required to sign the following declaration:—“I do solemnly and sincerely declare that while a Fellow (or Associate) of the Institute of Chemistry I will observe the Regulations thereof; that I will demean myself honourably in the practice of my profession, and to the utmost of my power maintain the dignity and welfare of the Institute.”

Such is a brief sketch of the proposed organisation which its promoters now wish to submit to the judgment of their professional brethren. The scheme, it will be observed, possesses considerable elasticity, and will doubtless undergo modifications after it has been put to the test of actual experience.

## TRADE IN DIPLOMAS.

ACCORDING to the *Allgemeine Chemiker Zeitung*, advertisements have appeared in many German political papers offering assistance in obtaining degrees, passing test-examinations, &c. Our contemporary, to sound the matter, wrote under a feigned name to the address given in the advertisement, asking for assistance to obtain a doctor’s diploma in the natural sciences. He received the following reply:—

“To your respected inquiry of the 17th inst., I beg to reply that we can furnish you with a scientific treatise of the extent of a good dissertation, in the strictest confidence on our part, within two months from date of order for the fee of 450 marks (£22 10s.). Half this sum is payable at the date of the order, the balance on delivery. We guarantee the excellence of the work with three-fourths of the fee. The following treatises in zoology can be delivered at once:—

“(1.) The skull of *Cynocephalus niger* considered with reference to theory of evolution, with the accompanying anatomical preparations.

“(2.) On the Branchiopoda, especially such as occur in Germany.

“The undersigned gives his word of honour (!) for the originality of the essays.”

The signature we suppress. Dr. Krause, the editor of the *Chemiker Zeitung*, remarks:—“Whilst in other cases offers of this nature are more or less distinctly fraudulent, it is in the present instance doubtful how a diploma-producing association, consisting apparently of learned men, can stoop to work out honours for a stranger, well knowing that he will be required to make a declaration tantamount to an oath that the dissertation is his own production.”

## NOTICES OF BOOKS.

*A Treatise on Chemistry.* By H. E. ROSCOE, F.R.S., and C. SCHORLEMMER, F.R.S., Professors of Chemistry in Owens College, Manchester. Vol. I. The Non-Metallic Elements. London: Macmillan and Co.

"It has been the aim of the authors," as we are told in the Preface, "to place before the reader a fairly complete, and yet a fair and succinct, statement of the facts of modern chemistry, whilst at the same time entering so far into a discussion of chemical theory as the size of the work and the present transition state of the science permit." The work commences with a historical introduction, upon which we may fairly congratulate the authors. The gradual development of the science is traced with great clearness; the discoveries which have served as turning-points are thrown into bold relief, without being disconnected from preparatory trains of thought and research, and the respective merits of the great masters of the past are discussed with a judicious impartiality. Thus while rendering full justice to the eminent merit of Lavoisier, and recognising his part in the foundation of modern chemistry, they admit that the charges brought against his good faith, especially as regards the discovery of oxygen, are "unfortunately but too well founded." Whether the countrymen of the great French chemist will acquiesce in the verdict thus pronounced by a German and an Englishman is, however, a different question.

In the account of the phlogistian controversy we find a passage which deserves attention:—"In considering this great discussion from our present point of view, we cannot but recognise in the phlogistic theory the expression of an important fact, of which, however, the true interpretation was unknown to the exponents of the theory. The phlogistonists assert that something, which they term phlogiston, escapes when a body burns; the antiphlogistians prove, on the other hand, that no escape of material substance then occurs, but that, on the contrary, an addition of oxygen (or some other element) always takes place. In thus correcting from one aspect the false statement of the followers of Stahl, Lavoisier and his disciples overlooked an interpretation which may truly be placed upon the statements of the phlogistonists, for if in place of the word 'phlogiston' we read 'energy' this old theory becomes the expression of the latest development of scientific investigation. We now know that when two elements combine, *energy*, generally in the form of heat, is evolved, whilst in order to resolve the compound into its constituent elements an expenditure or absorption of an equal amount of energy is requisite."

Passing from this historical survey to the body of the work, we are first struck with the number and the excellence of the illustrations, which in clearness and minute accuracy may be considered unrivalled. These merits belong not merely to the figures representing apparatus as employed in the laboratory, but to those explanatory of manufacturing plant on the large scale. As an instance we must refer to the account given of the manufacture of sulphuric acid. Here we find, first, a general or bird's-eye view of a sulphuric-acid works, and afterwards a set of figures drawn to scale, and giving the plan, the longitudinal section, and a sectional elevation in another direction indicated "of one of the most complete forms of sulphuric-acid works now in use in this country." In addition, these illustrations show the arrangement of the nitre-pots in plan and section, the improved arrangement of platinum stills as devised by Messrs. Johnson and Matthey, and the plan of a rectifying-house where the process of concentration is conducted in glass vessels. It is impossible to overrate the value of this feature in the work before us. To be able to direct the arrangement of plant for any particular chemical manufacture is one of the most important duties of the practical chemist. No one else can fully understand the requirements of the

case or decide what is necessary for efficient working. Hence, unless the chemist is able to direct the engineer or the architect—to explain to them distinctly what is wanted—a misarrangement of plant is very probable. This part of the training of chemists has been hitherto, in England, much neglected. We have seen instances of young men who, on receiving an appointment in some chemical manufactory, were utterly strange to its arrangement. They were well versed in chemical theory, careful and expert analysts, but their ignorance of manufacturing work and of its conditions was at once visible to every labourer in the establishment. Such ignorance delights all rule-of-thumb men,—who are yet very common in chemical works in the capacities of foremen, managers, and even masters,—brings Science into contempt, and thus retards the development of our national industry. We will venture to say that the student who has carefully examined the figures relative to the manufacture of sulphuric acid in the work before us, and read the accompanying descriptions, will be in no danger of stultifying himself if called upon to take part in the management of a sulphuric-acid works.

The descriptions of other important manufacturing processes are rendered intelligible in a similar manner. Indeed it is not too much to say that, in virtue of its style of illustration alone, the work of Professors Roscoe and Schorlemmer may claim a place along with and complementary of the great systematic productions of Watts and of Gmelin, with the additional recommendation of being brought down to the most recent state of the Science. One slight objection we must, however, take as regards some of the figures of manufacturing plant. In certain cases—*e.g.*, the manufacture of sulphuric acid—the appended scale is on the metric system, whilst in the diagrams relative to hydrochloric acid it is given in feet. The adoption of one uniform standard would have obviated possible mistakes.

As regards the text of the book before us, all who are acquainted with the smaller works of Prof. Roscoe will consider his name a guarantee for clearness of arrangement and exposition. The most recent results of experimental research, as far as authenticated, and the most advanced theoretical views are here embodied. Fulness without prolixity has been successfully aimed at, and references to original memoirs direct the student who may require details for which the scope of the work is insufficient. An important feature—which may be foreseen from our remarks on the illustrations—is that the work recognises no gulf between theory and practice, and deals with the chemistry of the factory as well as with the more refined operations of the laboratory. How great a boon this must prove to the student, and ultimately to the manufacturer and the nation, does not require to be further shown. The authors do not consider the list of the supposed elementary bodies completed, nor do they hold that these bodies are necessarily incapable of decomposition.

Great credit is due to the publishers for the excellent style in which so admirable a work is presented to the scientific public.

## CORRESPONDENCE.

## SPECIFIC GRAVITY APPARATUS.

*To the Editor of the Chemical News.*

SIR,—It appears that the specific gravity apparatus described in the CHEMICAL NEWS, vol. xxxvi., p. 168, is not new. It is described as Hare's hydrometer in *Bird and Brooke's Nat. Phil.*—I am, &c.,

JAMES TAYLOR.

Metallurgical Laboratory, Owens College,  
October 17, 1877.

SPECIFIC GRAVITY APPARATUS.

To the Editor of the Chemical News.

SIR,—One charge may be brought against the younger chemists of the present day—that of not reading up the records of past work done by their predecessors. Were this done more punctually we should have fewer reproductions of old inventions. For instance, the "Simple Specific Gravity Apparatus for Liquids" (only much improved), of Mr. James Taylor, appeared in the CHEMICAL GAZETTE, vol. ii., p. 125, and dated January 9, 1844. Thus, whatever merits it may possess of utility, it cannot lay claim to more novelty than thirty-three years will allow.—I am, &c.,

P. H.

CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 15, October 8, 1877.

**Apparatus for Measuring the Evaporation-heat of Liquids.**—M. Berthelot.—This apparatus cannot be described in an intelligible manner without the aid of the accompanying illustration.

**Determination of the Heat of Fusion.**—M. Berthelot.—The solidification of liquids, and especially of the hydrocarbons, is rarely as sharply defined as that of water, many bodies solidifying gradually, and preserving a soft paste-like condition during a certain interval of temperature. The measurement of the heat of fusion becomes then very difficult, for it is not possible to confine ourselves to determining the heat given off by the substance whilst it is solidified at a stationary temperature, as the definitions of physicists require. The author has verified the observation that chloral hydrate solidifies and crystallises at an apparently fixed temperature of 46°, but he has also found that the heat thus liberated during the solidification of 1 grm. of chloral hydrate amounted merely to +17.6 calories, whilst the heat absorbed during the fusion—effected likewise at 46°—is +33.2 calories, or nearly double. The two phenomena are not reciprocal when they succeed each other immediately, and only become so when they are separated by a very considerable time, which in the present case amounts to several months. The author's method consists in bringing the body under examination to a certain final condition, proved to be identical by thermic experiments; a demonstration the necessity of which had not struck early observers. As regards chloral hydrate, this identic final condition, suitable for defining the different states of this body, was obtained by dissolving it at a given temperature and in a constant quantity of water.

**Remarks on the Variations of Temperature liberated by the Union of Water and of Sulphuric Acid at Different Temperatures.**—M. Berthelot.—The union of  $S_2O_8H_2$  with  $H_2O_2$  liberates approximately the same amount of heat at every temperature bordering upon 15°. For the union of  $S_2O_8H_2, H_2O_2$  with  $H_2O_2$  there is an increase of 112 calories between 10° and 24°.

**The Ratio which should exist between the Diameter of Electro-magnetic Nuclei and their Length.**—M. Th. du Moncel.—For equal circuit-resistances the diameters of an electro-magnet should be proportionate to the electromotive forces. For equal forces these diameters should be inversely as the square root of the resistance of the circuit, including the resistance of the battery. For equal diameters the forces should be proportional to the square roots of the resistances of the circuits. For a

given electromotive, and with electro-magnets placed in their maximum conditions, the forces of the batteries which ought to actuate them should be proportional to the square roots of the resistances of the circuit.

**Pyrogenous Decomposition of the Hydrochlorate, Hydrobromate, and Hydriodate of Trimethylamin; Novel Characteristic of the Methylamins.**—M. Camille Vincent.—The production of methylic chloride, bromide, and iodide by the pyrogenous decomposition of methylamin hydrochlorate, hydrobromate, and hydriodate is a new characteristic of these compound ammonias.

**Iodide of Starch.**—M. Bondonneau.—The iodide of starch is a definite compound, its composition being represented by the formula  $(C_{12}H_{10}O_{10})_3I$ . It is decomposed, with regeneration of the original starch, by all sources of nascent hydrogen, and is again produced by the limited action of oxidising agents in the cold, even by the mere action of the atmosphere. Except present in excess, iodine is not eliminated by its solvents, such as potassium iodide, benzol, carbon bisulphide, &c., except alcohol, whilst these solvents separate it from the red compound which it forms with dextrin  $\alpha$ . If kept suspended in water for a year it is slightly decomposed; a portion becomes soluble in water, which then contains dextrin  $\alpha$ , coloured red by iodine, and hydriodic acid, but no glucose. The insoluble portion retains the same composition.

**Description of the Meteorites of Rochester, Warrenton, and Cynthiana, fallen respectively December 21, 1876, January 3 and 23, 1877, with Remarks on Former Falls of Meteorites in the Same Region.**—Lawrence Smith.—These three falls of meteorites have taken place within a period of thirty-two days, and within a tract of country of about 2° lat. by 6° lon. They differ, nevertheless, in their mineralogical constitution, none of them belonging to the most common type. The Rochester meteorite, though apparently very large, seems to have been dissipated in small fragments. The portion found at Rochester did not weigh more than 400 grms. Its texture is globular. It consists of 46.8 per cent of soluble and 53.2 of insoluble matter; its specific gravity is 3.55, and it contains minute grains of nickeliferous iron. Of the Warrenton meteorite from 5 to 7 kilos. have been preserved. Its specific gravity is 3.47, and the proportion of metallic grains is very small. The proportion of the constituent minerals is about as follows:—

Periodite .. .. .	76.0
Bronzite and pyroxen .. .. .	18.0
Nickeliferous iron.. .. .	2.0
Troilite .. .. .	3.5
Chrome iron .. .. .	0.5

The weight of the Cynthiana meteorite is about 6 kilos. Its specific gravity is 3.47. From its chemical analysis the following mineralogical composition has been adduced:—

Periodite .. .. .	50.00
Bronzite .. .. .	38.00
Nickeliferous iron .. .. .	6.00
Troilite .. .. .	5.50
Chrome iron.. .. .	0.52

100.02

Of the twelve falls of meteorites, of which specimens have been collected in the United States during the past eighteen years, eight, representing more than 1000 kilos. of matter, have fallen in the regions of the prairies of the West, and on a surface not exceeding one-eighth of the extent of the United States. This cannot be explained by the assumption that this region is more populous, and that there are consequently more observers.

**Synthesis of Benzoic Acid and of Benzophenon.**—MM. Friedel, Crafts, and Ador.—The process devised by the authors, although yielding chloride of benzoyl, and consequently benzoic acid, does not lead to a practical method for the preparation of this acid, but it enables benzophenon to be obtained in any quantity. Oxychloride

of carbon was prepared in the ordinary manner by causing chlorine to act upon carbonic oxide exposed to the sun. The excess of chlorine was removed by passing the gas, still in sunshine, into benzol and then over zinc-turnings. The gas traverses a series of bottles containing benzol mixed with aluminium chloride. The process lasts from six to twenty hours. At the end, each of the bottles, especially the first, contains benzophenon in solution, which is isolated by treatment with water to remove chloride of aluminium, and by distilling the benzol after washing with potassa. In these reactions benzoic acid was obtained merely in traces.

### NOTES AND QUERIES.

**Soda-Ash Manufacturers.**—A correspondent wishes to procure as complete a list as possible of the French and German soda-ash manufacturers.

### MEETINGS FOR THE WEEK.

THURSDAY, Nov. 1.—Chemical, 8. "On some Hydrocarbons Obtained from the Homologues of Cinnamic Acid," by W. H. Perkin, F.R.S. "On Anethol and its Homologues," by W. H. Perkin, F.R.S. "On Two New Methods for Estimating Bismuth Volumetrically," by M. M. P. Muir.

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# THE CHEMICAL NEWS.

VOL. XXXVI. No. 936.

## REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.\*

By Dr. A. W. HOFMANN.  
(Continued from p. 188.)

*Phosphorus and Matches.* By Dr. ANTON VON SCHRÖTTER,  
Master of the Imperial Mint at Vienna.

Few substances are so calculated to excite our interest from every point of view so decidedly as phosphorus. Its relations especially to the organic world claim especially our whole attention.

This element, discovered nearly two centuries ago by Brand and afterwards described by Kunkel, has been therefore the subject of many investigations, and yet many of its properties are even yet not satisfactorily understood.

Phosphorus was first obtained from human urine, and a hundred years afterwards it was shown by Gahn to be an essential constituent of bones. From this fact its universal diffusion in nature might have been inferred, but it has been only of late demonstrated that not merely most substances found on the earth's surface contain phosphorus, but that it is present in most springs, in all rivers, in the sea, and even in the atmosphere (Barral), although but in slight traces. In fact upon a soil free from compounds of phosphorus no plant could grow. In this respect, therefore, phosphorus ranks among the elements necessary for building up the vegetable and animal body, like oxygen, nitrogen, carbon, hydrogen, chlorine, sulphur, iron, calcium, &c.

Let us now, as far as our immediate purpose allows, consider the properties of phosphorus more closely.

The only kind of phosphorus which was known up to 1848, and which exclusively occurred in trade, and is still known as "ordinary," is a yellow translucent, and, when recently prepared and preserved from the action of light, perfectly limpid body, brittle at low temperatures, but assuming at 15° C. the consistence of wax. Notwithstanding this cerous consistence it still possesses a perfectly crystalline texture, as may be readily perceived by exposure for some time to the action of dilute nitric acid, which attacks it slightly, leaving a surface like that exhibited by tin after treatment with a dilute acid. The single crystals obtained from solvents are decidedly octahedra, exactly agreeing in appearance with common phosphorus, which may therefore justly be called the octahedral. Mitscherlich, however, has observed phosphorus crystallised in dodecahedra.

On exposure to a moist atmosphere phosphorus is luminous in the dark in consequence of a very gradual oxidation and formation of phosphorous acid, which gradually passes into the phosphoric. At the same time a small part of the uncombined oxygen is converted into the modification known as ozone.

The phosphoric vapours hereby diffused exert a very poisonous action if inhaled, producing a disease known as phosphorus necrosis, which begins with the disintegration of the jaw-bones and ends with their total destruction, and under which ill-fed and scrofulous persons sink with peculiar rapidity. Phosphorus introduced into the stomach acts likewise as a violent poison.

With regard to its chemical behaviour phosphorus must

be placed in the same group of elements as nitrogen, arsenic, antimony, and perhaps some other of the simple bodies.

If preserved under water and exposed to daylight ordinary phosphorus is covered with a white crust which gradually becomes detached. The nature of this body was for a long time doubtful. Baudrimont,\* however, has shown that this crust is formed only under access of oxygen, and possesses all the attributes of ordinary phosphorus, whence we can scarcely doubt that it is merely common phosphorus which, assisted by the presence of the water, crumbles away from the sticks corroded by oxygen.

We may here also refer to the long-known, so-called black phosphorus, which, according to Thénard, may be obtained by rapidly cooling phosphorus—previously often distilled—an operation which, be it remarked, has never succeeded in the hands of the writer of this report. According to Blondlot† phosphorus also becomes black when cooled slowly, but it must be perfectly pure and limpid. The black colour is said to depend upon a black body, very minute traces of which are mixed with common phosphorus, which is left behind on solution in carbon bisulphide and passes over first on distillation, so that the last drops are colourless. Black phosphorus is rather softer than the ordinary kind, but is otherwise scarcely distinguishable. The nature of the black substance accompanying ordinary phosphorus, the formation of which is said to be promoted by mercury, though the latter element forms no part of its composition, is as yet unknown. It may be, as Blondlot supposes, a peculiar modification of phosphorus or a mere impurity.

Since 1848 an allotropic modification is met with in commerce under the name of *red*, or, preferably, as it is never a pure red and varies in colour according to circumstances, *amorphous* phosphorus. This form differs from the octahedral phosphorus in its most important attributes in a degree almost as great as do the allotropic modifications of carbon—soot, graphite, and diamond—among themselves.‡

Amorphous phosphorus in compact pieces is an opaque reddish brown substance of imperfect metallic lustre, but where recently broken almost of an iron black. It is brittle, easily broken, and exhibits a perfectly conchoidal fracture with sharp edges. Its sp. gr. is 2.105; in hardness it lies between calcareous spar and fluor-spar. The colour of the powder, and consequently of the streak, is reddish brown, exactly resembling that of ignited ferric oxide, otherwise known as colcothar.

Amorphous phosphorus is tasteless and inodorous, insoluble in all liquids which dissolve the octahedral variety, and consequently not poisonous. If taken into the stomach in considerable quantity it is excreted unchanged, and resists, therefore, the powerful oxidising process in the animal body.

It is absolutely incapable of ignition by friction, and is therefore portable without danger. As the lumps, however, generally contain some ordinary phosphorus in

\* Baudrimont, *Comptes Rendus*, lxi., 857, 1866; *Zeitschr. f. Chem. N. F.* ii., 31, 1866.

† Blondlot, *Comptes Rendus*, lx., 830; *Gmelin Handbch. der Chemie* (Kraut's edition), i. Abth., 2, 103.

‡ In the Official Report on Group III, Section 5, published by the General Direction of the Vienna Exhibition, occurs on p. 3 the following passage:—"Shortly after the non-poisonous and sparingly combustible red modification of phosphorus had been discovered in Schrötter's laboratory, &c." This passage, if it is to be conformable with the truth, should read: "Shortly after the non-poisonous modification of phosphorus had been discovered by Schrötter. I am therefore, after the lapse of twenty-seven years, once more compelled to explain that no one who at that time was working in my laboratory has a claim to any even mentionable share in this discovery. I observed the first facts relative to this matter in 1845, on which communications may be found in the *Reports of the Sessions of the Imperial Academy of Sciences of Vienna*, Bd. i., p. 25, and in the *Memoirs*, Bd. i., p. 1., and ii., 127. Also in the *Reports of Sessions*, Bd. i. p. 48; Bd. iv., p. 59, and p. 156. Other matter connected with this subject has been collated with historical accuracy in the "Reports by the Juries," Class ii., Sect. A. of the London Exhibition of 1862, drawn up by A. W. Hofmann. See art. "Phosphorus," p. 93.—A. v. S.

\* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

small portions they have to be forwarded in water, since they might otherwise take fire if broken or rubbed. But even then the combustion proceeds very slowly. In the form of powder amorphous phosphorus may be conveyed in tin boxes without any danger.

As commonly met with in trade the pulverulent amorphous phosphorus contains likewise small quantities of ordinary phosphorus—from 0.6 per cent downwards, according to Fresenius. It is therefore slowly oxidised on exposure to the air and has an acid reaction.

It has been also maintained that amorphous phosphorus, even in the absence of any intermixture of the ordinary variety, is slowly oxidised in the air. This is, however, doubtless an error, since the writer has preserved pure amorphous phosphorus for years spread upon paper and freely exposed to the air without any trace of an acid reaction becoming perceptible. It is still, however, possible that there are circumstances not yet ascertained in which amorphous phosphorus, even in the absence of any admixture of the octahedral kind, may become acidified by the air. Such a behaviour, though often occurring, by no means ranks among the normal attributes of this modification of phosphorus.

In addition to ordinary phosphorus and phosphorous acid, the amorphous phosphorus of commerce contains, inclusive of water, 4.622 per cent of other impurities, amongst which is always found graphite, derived from the iron vessels in which the preparation takes place.

For ignition amorphous phosphorus requires a temperature of at least  $240^{\circ}$ . In nitric acid it dissolves on account of its state of subdivision, far more readily than the common variety, because the latter, as a fused mass, offers a much smaller extent of surface for the attack of the acid. Chlorine which combines with common phosphorus with ignition has no action upon the amorphous modification. If heated in a rapid current of chlorine it burns with a yellow luminous flame.

The products of the reaction of various substances upon the two modifications of phosphorus are exactly identical, a circumstance not observed in case of other elements occurring in allotropic forms; *e.g.*, carbon, according to the researches of Brodie, Berthelot, and Stingl.

The conversion of common phosphorus into the amorphous state is effected by exposure to light or to the prolonged action of a temperature of  $240^{\circ}$  to  $250^{\circ}$ . The transformation may be effected at  $215^{\circ}$ , but more slowly. At  $260^{\circ}$  re-conversion begins into ordinary phosphorus, the boiling-point of which, under average pressure, is about  $290^{\circ}$ . The transition from one allotropic state to the other can be more readily shown in the case of phosphorus than in that of any other element. All that is required is a glass tube closed with mercury and with several bulbs blown on its horizontal limb. Some common phosphorus is placed in the first bulb at the end of the tube, which on the application of heat ignites and consumes all the oxygen contained in the tube. The residue of the phosphorus is driven into the second bulb, converted there by cautious heating into the amorphous variety, and can then again be distilled into the third bulb in the state of ordinary phosphorus.

In 1865 Hittorf,\* in a very valuable dissertation which essentially enlarged our knowledge of phosphorus, described a substance which he obtained on exposing amorphous phosphorus along with lead to a red heat in an exhausted glass tube. After cooling, black crystalline leaflets of a metallic lustre were found on the surface of the lead, and were regarded by Hittorf as phosphorus in a new allotropic modification, which he designated as the "metallic crystalline." It would be out of place to enter here upon a detailed examination of Hittorf's interesting observations, but mention must be made of the fact that common phosphorus exposed to temperatures exceeding  $300^{\circ}$  C. in closed vessels, and consequently exposed to considerable pressure, is transformed into the amorphous

condition in a few minutes. As during this conversion a notable elevation of temperature takes place, the pressure upon the sides of the apparatus must be very great. Hittorf is of opinion that manufacturers engaged with the preparation of amorphous phosphorus will welcome such an abridgment of the process. The question, however, arises whether, in the treatment of large quantities, difficulties, and even dangers, might not arise far outweighing the economy of time. According to the present method, when the conversion is effected in open iron vessels in which the air finds but limited access, the process is more tedious, but free from all difficulty.

*Manufacture of Phosphorus.*—The bulk of the phosphorus is still prepared in the manner indicated by Nicolas and Pelletier. From the bone-earth  $\text{Ca}_3(\text{PO}_4)_2$  is obtained the primary phosphate,  $\text{CaH}_4(\text{PO}_4)_2$ , by treatment with sulphuric acid. This is converted by heat into calcium metaphosphate,  $[\text{Ca}(\text{PO}_3)_2]$ , and is then mixed with charcoal powder and distilled at a strong red heat.\* Stoneware tubes are preferable to the retorts formerly in use, and care must be taken to allow the gases to escape unhindered so that there is no pressure to overcome. The importance of this in all cases where it is requisite to catch and condense vapours escaping from ignited earthen apparatus, will appear from the fact that not a trace of carbon bisulphide can be collected if its vapour has to overcome even a very slight pressure in earthenware apparatus.

The purification of crude phosphorus from impurities present in mechanical admixture, such as charcoal, &c., is best effected by forcing it at a slight pressure through leather by means of a Real's press, kept hot.

The residue (re-generated calcium tri-phosphate) is an excellent clarifying agent, especially for glycerin, and is in great request for this purpose.

The conversion of ordinary phosphorus into the amorphous condition is effected in iron boilers heated to  $240^{\circ}$ , and left open, but so that the air finds scanty admission through a narrow and rather long tube. The danger of explosion is thus obviated and very little phosphorus is burned, since the interchange of air in the boiler takes place very slowly, whilst the phosphorus consumes all oxygen so rapidly that within the boiler scarcely a trace of this gas is present. The amorphous phosphorus thus obtained, and still always retaining some of the ordinary modification, is ground under water, boiled with soda-lye to remove octahedral phosphorus, washed, and dried.

(To be continued.)

## CHROMIUM CRUCIBLE CAST-STEEL.

By SERGIUS KERN, St. Petersburg.

Most of the crucible steel is at present prepared by melting in fire-clay crucibles suitable mixtures of puddled steel, iron, steel or iron filings, with the addition of iron magnetic oxide as a flux and ferromanganese in order to reduce the oxides of iron resulting from the oxidation of the melted metal. When hard steel, the so-called instrumental steel, is desired, the iron or iron filings are replaced by refined cast-iron in the above-mentioned mixtures. The bars of puddled steel before being cut into pieces (1 inch by 1 inch) are ordinarily classified by their degree of hardness; this is done by breaking them by means of a hammer. But as the puddled bars are never uniform in respect of the percentage of carbon, the production of a required percentage of carbon in cast-steels is a rather difficult task. The following tables show to some extent the fluctuation of the percentage of puddled steels obtained by the ordinary way and by rolling the puddling blooms

\* For further particulars see article "Phosphorus," by A. W. Hofmann in the already quoted "Report of the Jury on the London Exhibition of 1862."

into bars. The combined carbon was determined by the Eggertz colorimetric method. The normal steels were tested by the oxidation of the carbon of steels by chromic acid, and next collecting the resulting carbonic acid in a potash apparatus. It must be mentioned that puddled steel for the preparation of crucible cast-steel is always puddled with wood previously dried in suitable furnaces in order to avoid the use of coal, containing more or less sulphur. The use of such fuel certainly increases the price of the steel blooms.

TABLES OF ANALYSES OF STEEL BARS.

Sets of Hard Steel Bars.

Sets of Soft Steel Bars.

Carbon.

Carbon.

Bar	I.	II.	Bar	I.	II.
A	0.77	0.58	A	0.18	0.18
B	0.77	0.58	B	0.18	0.22
C	0.51	0.31	C	0.22	0.18
D	0.58	0.31	D	0.22	0.18
E	0.58	0.31	E	0.47	0.18
F	0.79	0.31	F	0.27	0.18
G	0.51	0.58	G	0.47	0.27
H	0.79	0.51	H	0.18	0.18
I	0.51	0.51	I	0.47	0.18
J	0.51	0.58	J	0.22	0.22
Mean	—	—	Mean	—	—
	near to 0.63	0.46		near to 0.29	0.20

These analyses are only a few representatives of analyses of such kinds of bars in my hands; they clearly show why the metallurgist is always blind in mixing raw materials for the preparation of cast crucible steel. The use of Bessemer or Siemens-Martin steels avoids this difficulty very well; these steels are far cheaper than puddled steel.

The following experiments were made in order to prepare solid steel without blow-holes by the crucible process, which would give a good resistance and a proper elongation. The use of the rather dear ferromanganese was avoided, and the only substitutes of it in the new process are ground chrome ironstone ( $\text{FeOCr}_2\text{O}_3$ ) and limestone previously calcined.

The annexed tables A and B show the composition of raw materials and receipts for the preparation of chromo-steel for various purposes. This steel is especially suitable for steel-casting direct in earth-moulds.

A. ANALYSES OF RAW MATERIALS FOR CASTING STEEL.

(a.) Bessemer Rolled Steel Bars.

	I.	II.
	Per cent.	Per cent.
Combined carbon .. ..	0.100	0.250
Silicon .. ..	0.006	0.010
Manganese .. ..	0.020	0.030
Sulphur .. ..	traces	0.005
Phosphorus .. ..	0.010	traces
Copper .. ..	none	none

(b.) Siemens-Martin Rolled Steel Bars.

	III.	IV.
	Per cent.	Per cent.
Combined carbon .. ..	0.400	0.600
Silicon .. ..	0.020	0.020
Manganese .. ..	0.030	0.130
Sulphur .. ..	0.010	none
Phosphorus .. ..	traces	0.001
Copper .. ..	traces	none

(c.) Iron.

	Per cent.
Combined carbon .. ..	0.12
Graphite .. ..	traces
Silicon .. ..	0.02
Manganese .. ..	traces
Sulphur .. ..	none
Phosphorus .. ..	none

(d.) Refined Cast-Iron.

	Per cent.
Combined carbon .. ..	4.25
Graphite .. ..	0.10
Silicon .. ..	0.03
Manganese .. ..	0.01
Sulphur .. ..	none
Phosphorus .. ..	none

(e.) Chrome Ironstone.

	Per cent.
Chromium oxide .. ..	65.51
Ferrous oxide ( $\text{FeO}$ ) .. ..	31.65
Sulphur .. ..	none
Foreign matter .. ..	2.60
Copper .. ..	none

(f.) Lime Calcined.

	Per cent.
Calcium oxide .. ..	90.750
Silica .. ..	1.500
Iron oxide .. ..	2.750
Sulphur .. ..	0.010
Phosphorus .. ..	0.005

The chrome ironstone and limestone are calcined and next ground. The raw metallic materials are used for preparing the steel in the form of pieces of a square form (1 inch by 1 inch). Raw products having closely the above-mentioned composition may be used for the further receipts for the preparation of cast-steels.

B. RECEIPTS FOR THE PREPARATION OF CAST-STEEL.

	I.	II.
	Kilogrms.	Kilogrms.
Bessemer steel, No. I. ..	24.00	10.00
" " No. II. ..	5.00	22.00
Iron .. ..	5.00	2.00
Chrome ironstone .. ..	0.75	0.65
Limestone .. ..	0.25	0.35

The percentage of carbon in the received steels is about 0.20 to 0.25 in steel in No. I., and 0.45 to 0.55 in steel in No. II.

	III.	IV.
	Kilogrms.	Kilogrms.
Martin steel, No. III. ..	20.50	2.00
" " No. IV. ..	4.50	19.00
Refined cast-iron .. ..	8.75	12.00
Chrome ironstone .. ..	0.75	1.25
Limestone .. ..	0.50	0.75

The percentage of carbon in the received steels is 0.80 to 0.90 in steel No. III., and 1.0 to 1.3 in steel No. IV.

The mixture for steel-preparing is placed into previously heated fireclay crucibles; the chrome ironstone and the lime are placed on the bottom of the crucible, and next it is filled with the other materials, entering into the composition of the receipt. Ordinary coke-crucible or Siemens gas crucible furnaces are used for the operation.

The resulting four numbers of steel are quite sufficient for nearly all purposes as following:—

- Steel No. I., for steel plates, rifle barrels.
- " No. II., for machinery parts, cannons, tyres, axles.
- " No. III., for instruments, cannon rings, saws.
- " No. IV., for chisels, planing tools, &c.

The annexed table shows the mean result of the mechanical tests of the above-mentioned steels. The steel ingots obtained were hammered to test bars, which after forging were cooled in water. From every number of the cast-steels mentioned in the tables six different specimens were examined.

Cast Steel. No.	Percentage of Carbon.	Tons per Square Inch.		Elongation in Inches.
		Began to Stretch.	Breaking Weight.	
1.	0.25	25.3	48.1	1.35
2.	0.49	26.1	49.2	1.24
3.	0.95	24.8	52.3	1.13
4.	1.20	27.1	54.7	0.62

The samples of steels contain 0.08 to 0.25 per cent of chromium; as ordinary, hard steels contained more chromium than the soft specimens.

In preparing steel by this process the use of manganese alloys is avoided, which, in many cases, while reducing the iron oxides, give steel containing phosphorus and sulphur, as these elements are found in ferromanganese very frequently. By the new process cast-steel of a very good quality may be had at very moderate price, as the Bessemer and Martin steels are at present cheap and carefully prepared.

Obouchoff Steel Works.

## ON THE ACTION OF VARIOUS FATTY OILS UPON COPPER.\*

By WILLIAM HENRY WATSON, F.C.S.

At the last meeting of this Association some interesting experiments were brought before you on this subject by Mr. W. Thomson. His experiments were confined chiefly to the determination of the extent of the action of various oils upon metallic copper, from the appearances of the oils and surface of the copper-plates after long exposures, and from the comparative acidity of the various samples. Having made some experiments in which I noted the appearances after exposures, and *determined* the amount of copper dissolved by the different oils used, I am able to speak of the rapidity with which some of them act, and now venture to bring the results before you.

The experiments were conducted as follows:—Into separate beakers 500 water-grain measures of each oil was poured, namely,—

- |                 |                   |
|-----------------|-------------------|
| 1. Linseed oil. | 6. Sperm oil.     |
| 2. Olive oil.   | 7. Castor oil.    |
| 3. Almond oil.  | 8. Neatsfoot oil. |
| 4. Colza oil.   | 9. Sesame oil.    |
| 5. Seal oil.    | 10. Paraffin oil. |

The above numbers will be mentioned farther on instead of mentioning in each case the name of the oil.

Into each of these samples of oil a piece of copper-foil exposing 8 square inches of surface was immersed. The beakers were then placed in a room above the Laboratory and covered by pieces of porous paper. The appearances were noted occasionally as follows, from which it will be seen that several of the oils acted somewhat rapidly upon the copper:—

### (a.) Examination after two days' exposure:—

1. The oil is slightly green near the copper. The copper is not changed in appearance.
2. The oil immediately surrounding the copper is of a slight green colour, and the copper is a little tarnished.
3. No change in the appearance of either the oil or the copper.
4. This oil is considerably more green than in oils 1 and 2. The copper is a little tarnished, not quite so much as that in No. 2.
5. The colour of this oil is now a light green. The appearance of the copper is not changed.
6. There is no apparent change in the colour of either the oil or the copper.
7. Ditto, ditto.
8. A little greenness in the oil. The copper has slight irregular brown markings on its surface, evidently on the impressions left by passing through the rollers.
9. The oil is slightly tinged a greenish yellow.
10. No change in either the oil or the copper.

Thus, with the exception of Nos. 3, 6, 7, and 10, all the samples had acted to some extent (from appearance) upon the copper by being exposed two days.

### (b.) Examination after five days' exposure:—

1. The appearance of this oil is similar to that when last observed, but the copper has a flocculent green deposit on some portions of it which were not then present.
2. This oil is more green than when last noted, while the copper is coated with a green deposit (a thin green skin) which is easily removed by agitating the oil.
3. This oil is of a very slight green colour. The appearance of the copper is not changed.
4. This oil is considerably green in colour. The copper remains as before.
5. The green colour of this oil is rather deeper than when last observed.
6. This oil is not changed in appearance. The copper is also as when first immersed.
7. There is a slight greenness in the oil immediately surrounding the copper. The appearance of the copper is not changed.
8. The appearance of this oil and copper is the same as when last observed.
9. The oil is slightly tinged a greenish yellow, about as when last observed. The copper remains as when first immersed.
10. No change noticeable.

Thus, by five days' exposure, all the oils had acted upon the copper with the exception of Nos. 6 and 10 (sperm oil and paraffin oil).

### (c.) Examination after ten days' exposure:—

1. The appearance of this oil and copper is as when last examined.
2. This oil appears about the same, with regard to colour, as when last noticed, but there is considerably more of the green deposit on the surface of the copper.
3. This oil is of a rather deeper green colour than when last examined, and the copper is slightly tarnished.
4. This oil is considerably green. The copper is a little tarnished.
5. The colour of this oil is a rather deeper green than when last noticed. No apparent change in the copper.
6. No greenness in the oil, but the copper is slightly tarnished.
7. This oil is tinged very slightly green. The copper remains as before.
8. This oil is considerably green, and the copper has become a little tarnished.
9. This oil is green, but not quite so green as No. 8. The copper remains bright.
10. No apparent change.

Here it is seen that, with the exception of No. 10 (the paraffin oil), the appearance of each oil indicated more or less action upon the copper during the ten days' exposure. After the above observations the various samples were examined quantitatively for copper. The method adopted may be described as follows:—The copper-foil is removed from the beaker, and as much of the oil allowed to drain from it as possible. Any deposit on the copper and any oil remaining is removed by cotton-wool. The oil is treated with hot water to which a few drops of nitric acid had been added, and violently shaken. On being allowed to stand, the solution separated from the oil is drawn off. This washing operation is repeated several times with pure water, and the whole of the washings collected. The cotton-wool used in removing the oil and any deposit from the surface of the copper is ignited, and the ash treated with a drop of nitric acid; this is then washed into the previous washings, and the whole, by addition of

\* Read before the British Association, Plymouth Meeting, Sec. B.

water, made to measure 4000 grains. This solution contains the whole of the copper dissolved by the oil under examination. A portion of it (generally 100 measures) is taken and diluted to 1000, a few drops of ammonium sulphide solution added, and the depth of colour produced compared with that produced similarly in a solution of copper of known strength. In the case of 100 measures of the washings being used the results are multiplied by 40, thus furnishing the total amount of copper present.

By such examination the amount of copper found in each of the samples of oil after ten days' exposure was as follows:—

1. Linseed oil	.. .. .	0.3000 grain.
2. Olive oil	.. .. .	0.2200 „
3. Colza oil	.. .. .	0.0170 „
4. Almond oil..	.. .. .	0.1030 „
5. Seal oil	.. .. .	0.0485 „
6. Sperm oil	.. .. .	0.0030 „
7. Castor oil	.. .. .	0.0065 „
8. Neatsfoot oil (English)	.. .. .	0.1100 „
9. Sesame oil..	.. .. .	0.1700 „
10. Paraffin oil	.. .. .	0.0015 „

The conclusions afforded by these quantitative results are not such as I should have drawn from the appearances of the various samples as previously noted; for while Nos. 4 and 8 were very much more green than any of the other samples, yet the amount of copper was larger in Nos. 1, 2, and 9. From this it would appear that some of the oils form a compound with copper having a deeper green colour than others, and that there may be, therefore, a greater depth of colour with a less amount of copper in one oil than in another. It follows, then, that we cannot satisfactorily conclude as to the action of different oils upon copper merely from the appearance of them after being in contact with it for some time. The considerable colour which very small quantities of copper produce in some oils (and especially in almond oil) is remarkable: there is therefore no difficulty in detecting the presence of copper, though to arrive correctly at the comparative quantity in different oils seems to be impossible, from mere observance of the appearances of the samples.

I commenced some fresh experiments with the view of exposing the samples for a much longer period, under the same conditions as the former ones. They were examined after seventy-seven days of exposure, but accidentally the sample of neatsfoot oil and the sample of sesame oil were damaged during the exposure. I am therefore only able to speak of the remaining eight samples, as follows:—

*Copper found in the Oil after Seventy-seven Days' Exposure.*

1. *Linseed Oil*.—This oil is very green. The green compound appears to be chiefly in solution. The copper is a little tarnished. 0.5435 of a grain.

2. *Olive Oil*.—This oil is very green; more blue than that in sample No. 1, and chiefly in suspension. This flocculent compound, which covers the copper, is easily removed, and when removed the surface of the metal is quite bright. 0.2400 of a grain.

3. *Colza Oil*.—This oil is of a yellowish green colour. A light transparent skin, of a green colour, has become attached to the copper. 0.1400 of a grain.

4. *Almond Oil*.—This oil is very green. It is a blue-green, and suspended in the oil: there is a flocculent compound of a similar colour. The surface of the foil is quite bright. 0.2200 of a grain.

5. *Seal Oil*.—Very green; not so blue a green as that in the almond oil. The copper is irregularly tarnished. 0.0800 of a grain.

6. *Sperm Oil*.—This oil is only very slightly green. The copper has a thin green skin attached to its surface. 0.0600 of a grain.

7. *Castor Oil*.—A very slight greenness in the oil. The copper is quite bright. 0.0100 of a grain.

8. *Paraffin Oil*.—No apparent greenness in the oil. The copper is quite bright. 0.0030 of a grain.

By deducting the amounts of copper found in the different samples exposed ten days from the amounts found in those exposed seventy-seven days, we arrive at the quantities dissolved between the two dates, thus:—

1. Linseed oil	.. .. .	0.2435 grain.
2. Olive oil	.. .. .	0.0200 „
3. Colza oil	.. .. .	0.1230 „
4. Almond oil..	.. .. .	0.1170 „
5. Seal oil	.. .. .	0.0315 „
6. Sperm oil	.. .. .	0.0575 „
7. Castor oil	.. .. .	0.0035 „
8. Paraffin oil..	.. .. .	0.0015 „

The action of the olive oil was greatest at its first exposure, for during the first ten days it had dissolved 0.22 of a grain, while in the following sixty-seven days it only dissolved 0.02 of a grain of copper, according to the experiments in the first and second series.

In conclusion, the results of my experiments show that, of the oils examined, paraffin oil and castor oil, when pure, have the least action upon copper, while the action of sperm oil and seal oil is but slight. The rest of the oils taken all act considerably, and the action of linseed oil is especially great.

Braystones, near Whitehaven,  
July, 1877.

## IODIDES AND IODATES.

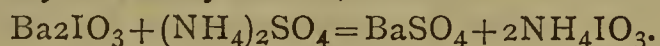
By WILLIAM STEVENSON.

THE following process is recommended for making iodic acid, hydriodic acid, and most iodides and iodates:—

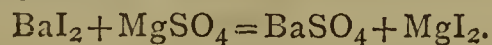
Dissolve 2 parts of baric hydrate in 4 parts of boiling water; add gradually 3 parts of iodine, and filter when the solution is neutral and colourless. The reaction is as follows:—



The precipitated iodate of baryta may be used for iodic acid by decomposing with sulphuric acid, filtering, and evaporating the filtrate to crystallisation *in vacuo*. By substituting an equivalent of any soluble sulphate the iodate may be readily formed, thus:—



The same applies to the filtrate containing the iodide of barium, which may be employed for hydriodic acid by adding sulphuric acid till no further precipitate occurs; or by decomposing with any soluble sulphate the corresponding iodide may be made:—



## TRADE IN DIPLOMAS.

WE extract the following from the *Chemiker Zeitung*:—  
“An advertisement in a German paper announces that doctors' diplomas of a highly respected university, which has hitherto not granted degrees *in absentia*, as well as orders and titles of different states, including the papacy, letters of nobility, &c., can be procured for suitable persons genuine and direct, and without prepayment, by Dr. ———, Ravensdon Street, London, S.E.”

The editor of the *Chemiker Zeitung* wrote to this address inquiring how the doctors' diplomas, orders, and titles were to be obtained, what were the qualifications required, and what was the charge for each degree of distinction. He received a prospectus partly printed, partly written, to this effect:—

“London.

“HONOURED SIR,

“In reply to your inquiry I beg to state that I am the sole representative of a new English university, and that

the conditions of graduation are as follows:—Degrees are given in all the faculties, in philosophie, medicine, law, theology, dentistry, chemistry, &c., and under certain circumstances in music. Every candidate must send in an accurate sketch of his life, a literally true account of his studies, certified by his word of honour, or testimonials of examinations which he has passed, and, where these are insufficient, a good dissertation founded upon original research. Gentlemen who have not the advantage of a university career, but whose position in life is such that a scientific qualification may be inferred, or who have acquired a general culture by private study, can receive the degree of Dr. Philos. on sending in an account of their life and a satisfactory dissertation.

“After a brief statement of his course of culture every candidate will be at once informed what qualifications will be demanded for the attainment of the degree of doctor. The graduation fees, &c., amount to 650 marks (£32 10s.). The university reserves the right of demanding original testimonials, which, however, will be returned to the candidate. The degree of doctor is by no means purchasable.

“For candidates who cannot graduate at this university, I can on merely sending in a sketch of life procure the degree of doctor in all faculties from the American University of Philadelphia, or the Livingstone University, for the total charge of £25.

“Only a single German university now grants degrees *in absentia*, and that only to candidates who have passed a “state examination,” and only in the faculties of philosophy and law. Degrees *in presentia* are granted to those only who can prove that they have studied for six terms at a university. I am prepared to give every assistance to such candidates.

“I must particularly call your attention to the fact that those diplomas only are genuine which bear the seal and signature of the commissioner here resident.

“As to the orders, titles of nobility, it is not my custom to state particulars to anonymous inquirers, as these are most delicate and confidential affairs, but I may tell you that I can offer you general- and vice-consulates’ gold and silver medals for merit in art or science, &c., for fees ranging from £12 10s. to £1250, and from different countries.”

We certainly feel curious to know the name of the newly-founded English university which grants degrees *in absentia* through a sole agency in the S.E. postal district.

## PROCEEDINGS OF SOCIETIES.

### MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, October 16, 1877.

E. W. BINNEY, F.R.S., F.G.S., President, in the Chair.

MR. MACKERETH, F.R.A.S., stated that he had observed an unusual disturbance of his magnetometer at Eccles on the day preceding the great storm of the 15th, and that similar disturbances often occurred immediately before or during great and violent atmospheric changes.

Mr. M. M. PATTISON MUIR, F.R.S.E., exhibited and gave a description of a modified form of Hofmann’s apparatus for determining vapour densities.

“Note on an Edible Clay from New Zealand,” by M. M. PATTISON MUIR, F.R.S.E.

I lately received from my friend Mr. R. E. Day, M.A., a small specimen of a clay which is greedily eaten by the sheep in a certain district in New Zealand.

The clay was brought by Mr. Day from Simon’s Pass

Station, Mackenzie country, South Island. It there forms a range of low bare hills: the sheep (merino sheep) eat very considerable quantities of the clay without appearing to be any the worse for it. So far as Mr. Day could learn, the clay-eating is confined to this particular part of the islands. It is supposed by the shepherds that the clay must contain salt, and that it is to supply the deficiency of this article of food that the sheep resort to the earth. The analysis shows that very probably the shepherds are right, although one would suppose that to consume so much silica and alumina for the sake of the small proportion of salt was hardly an economical proceeding on the part of the sheep.

The alkali was determined by Lawrence Smith’s process of fusion with calcium carbonate and ammonium chloride. The water was determined by heating in a stream of dry air, and direct weighing of the moisture expelled; the organic matter, by noting the difference between the amount of water thus obtained and the total loss suffered on ignition.

Silica	..	..	..	..	..	..	61.25
Alumina	..	..	..	..	..	..	17.97
Ferric oxide	..	..	..	..	..	..	5.72
Calcium ditto	..	..	..	..	..	..	1.91
Magnesium ditto	..	..	..	..	..	..	0.87
Alkalies* (as chlorides)	..	..	..	..	..	..	3.69
Organic matter	..	..	..	..	..	..	1.77
Water	..	..	..	..	..	..	7.31

100.49

“On the Decomposition of Calcium Sulphate by Alkaline Chlorides: a Contribution to Agricultural Chemistry,” by M. M. PATTISON MUIR, F.R.S.E.

In one of his papers upon Diffusion† Graham describes experiments which prove that a solution of potassium or sodium sulphate in lime-water, when allowed to diffuse into lime-water, yields a diffusate containing potassium or sodium hydrate; but that a solution of potassium or sodium chloride is not decomposed by lime-water under the same circumstances. Graham further shows that when solutions of calcium sulphate and potassium or sodium chloride are mixed, no decomposition ensues at the ordinary temperature, but that on boiling the mixed liquids for some time sulphate of sodium (or of potassium) is found, and continues to exist in the cold solution, inasmuch as if lime-water be added two or three days after the boiling has been carried out, and the mixture be allowed to diffuse into pure water, caustic soda or potash is found in the diffusate. Graham suggests that if solutions of calcium sulphate and sodium or potassium chloride be allowed to react one upon another for a considerable time, at ordinary temperatures, a decomposition might slowly take place analogous with that which is quickly produced when the mixed solutions are heated. If such a decomposition indeed take place, we shall have, says Graham, a reaction, which, occurring in the soil, may lead to the ultimate production of those alkaline carbonates required by plants for their nutrition. The steps in the process would be these:—Decomposition of the alkaline chloride by calcium sulphate, with production of alkaline sulphate; decomposition of the alkaline sulphate by lime, added to or originally present in the soil, with production of alkaline hydrate; transformation of the alkaline hydrate into carbonate by the action of carbonates in the soil, or of carbonic acid in the water and air.

The investigations of Graham and others have shown that the two last stages are readily accomplished.

2. In order to determine whether the first stage in the series of transformations is or is not attainable, I mixed solutions of calcium sulphate and sodium chloride, and allowed the liquids to remain at the ordinary temperature

\* The alkali consisted almost entirely of soda. The clay contained small quantities of phosphoric acid.

† “On the Application of Liquid Diffusion to produce Decomposition.”—*Journ. Chem. Soc.*, iii., 60.

f the air (15° to 18°) for several weeks. If decomposition had taken place the liquids would contain calcium sulphate, sodium chloride, calcium chloride, and sodium sulphate: the first of these salts is insoluble in ordinary alcohol; hence the addition of alcohol to the mixture would throw down the whole of the calcium sulphate existing as such, without otherwise influencing the state of equilibrium of the various salts in the liquid. In order to determine the amount of calcium sulphate which had undergone decomposition it was therefore only necessary to wash the precipitate produced by adding alcohol, with dilute spirit, and to ignite and weigh it.

The following are my results:—

(a.) 100 c.c. of  $\text{CaSO}_4$  solution = 191.0 m.grms.  $\text{CaSO}_4$  mixed with 10 c.c. of  $\text{NaCl}$  solution = 233.3 m.grms.  $\text{NaCl}$ .

Amount of  $\text{CaSO}_4$  in solution after twenty-eight days = 167.0 m.grms.

Hence amount of  $\text{Na}_2\text{SO}_4$  found = 25 m.grms.

(b.) 100 c.c.  $\text{CaSO}_4$  solution mixed with 50 c.c.  $\text{NaCl}$  solution = 1166.5 m.grms.  $\text{NaCl}$ .

Amount of  $\text{CaSO}_4$  in solution after twenty-eight days = 103.0 m.grms.

Hence amount of  $\text{Na}_2\text{SO}_4$  produced = 93.9 m.grms.

(c.) 100 c.c.  $\text{CaSO}_4$  solution mixed with 100 c.c.  $\text{NaCl}$  solution = 2333 m.grms.  $\text{NaCl}$ .

Amount of  $\text{CaSO}_4$  in solution after twenty-eight days = 64.0 m.grms.

Hence amount of  $\text{Na}_2\text{SO}_4$  produced = 132.7 m.grms.

3. It is very evident, then, that Graham's supposition is correct. Without the aid rendered by diffusion, time alone is sufficient to bring about a decomposition of calcium sulphate in solution by sodium chloride, also in solution. If this decomposition is then realised in the Laboratory, there can be little doubt that under the more favourable conditions offered by the soil the decomposition will play a somewhat important part in the nutrition of plant-life.

4. The numbers which I have obtained show that the extent of the decomposition under consideration is influenced not only by the time during which the salts are allowed to remain in contact, but also by the mass of sodium chloride employed. The amount of chemical action is almost directly proportional to the mass of the sodium chloride employed, the amount of calcium sulphate remaining constant.

"On some Thionates," by H. BAKER, Student in the Owens College. Communicated by Professor C. SCHORLEMMER, F.R.S.

Having been lately working on these salts, I offer the following observations:—

**Barium Dithionate**,  $\text{BaS}_2\text{O}_6\text{Aq}$ .—According to Heeren\* this salt is soluble in 1.1 parts of boiling water; but he does not give the boiling-point of the saturated solution: this I have observed to be 102°, and its solubility at this temperature to be 1 in 0.994 parts of water. It is remarkable that the saturated solution of such a soluble salt should boil at so low a temperature. The sp. gr. of the crystals of this salt at 13.5 is 4.536.

**Lead Dithionate**,  $\text{PbS}_2\text{O}_6\text{Aq}$ .—"Is very easily soluble in water" (Watts). I find its solubility at 20.5° to be 1 in 0.869 part of water. Its sp. gr. at 11° is 3.259.

**Calcium Dithionate**,  $\text{CaS}_2\text{O}_6\text{Aq}$ .—The crystals have a sp. gr. of 2.176 at 11°.

**Nickel Dithionate**,  $\text{NiS}_2\text{O}_6\text{Aq}$ .—One part of this salt dissolves in 0.897 part of water at 12°.

**Magnesium Dithionate**,  $\text{MgS}_2\text{O}_6\text{Aq}$ .—According to Watts's Dictionary "forms six-sided tables, very soluble in water;" but Gmelin says it forms ill-defined six-sided prisms. I obtained it in oblique prisms, and found its solubility at 17° to be 1 in 0.692 part of water.

**Sodium Dithionate**,  $\text{Na}_2\text{S}_2\text{O}_6\text{Aq}$ .—Its sp. gr. at 11° is 2.175. Watts says "it crystallises by spontaneous evaporation in large transparent right-rhombic prisms."

Gmelin gives several measurements, but they are not sufficient to calculate all the forms from. My measurements show the crystals to be rhombic, and the axes to be—

$$\bar{a} : \bar{b} : c = 0.9922 : 1.0000 : 0.5981;$$

the forms occurring are  $\infty P$ ,  $\bar{P}\infty$ ,  $P$ ,  $\bar{P}\frac{1}{2}$ ,  $\infty P\infty$ , and the type is long prismatic, through predominance of  $\infty P$ . In these and the following angular measurements the interfacial angles are denoted as in "Kopp's Krystallographie," viz.:—

A = the angle of a pyramid over a vertical edge in the brachy-diagonal.

B = the angle of a pyramid over a vertical edge in the macro-diagonal.

C = the angle of a pyramid over a lateral edge.

W = the acute angle in the vertical prism, and the lateral angle in a dome.

Form.	Angle.	Calculated.	Found.	Gmelin.
P	A	125 45	125 40	125 48
	B	125 18	125 29	125 18
	C	81 11	—	80 18
$\bar{P}\frac{1}{2}$	A	88 39	88 34	—
	B	137 43	137 40	—
$\infty P$	W	89 33	89 25	89 22 and 89° 36'
$\bar{P}\infty$	W	62 9	62 3	62 12

**Silver Dithionate**,  $\text{Ag}_2\text{S}_2\text{O}_6\text{Aq}$ , forms, according to Watts, right-rhombic prisms, isomorphous with sodium dithionate. Gmelin gives some measurements. I find the axes to be—

$$\bar{a} : \bar{b} : c = 0.9884 : 1.0 : 0.5811,$$

and the forms  $\bar{P}\infty$ ,  $P$ ,  $\infty P$ ,  $\bar{P}\frac{1}{2}$ ,  $\infty \bar{P}\infty$ ,  $\infty \bar{P}\infty$ ; the type is very short prismatic.

Form.	Angle.	Calculated.	Found.	Gmelin.
P	A	126 47	126 51	127 0
	B	126 6	125 55	126 0
	C	79 9	79 8	79 10
$\bar{P}\frac{1}{2}$	A	89 54	89 58	90 12
	C	104 58	104 52	—
$\infty P$	W	89 20	89 22	89 8
$\bar{P}\infty$	W	60 54	61 1	—

**Silver Sodium Dithionate**,  $(\text{AgNa})_2\text{S}_2\text{O}_6\text{Aq}$ , is, according to Watts, "apparently isomorphous with the component salts." I find it to be rhombic with the axes—

$$\bar{a} : \bar{b} : c = 0.9813 : 1.0000 : 0.5856,$$

and the forms  $\bar{P}\infty$ ,  $P$ ,  $\infty \bar{P}\infty$ ,  $\infty P$ ,  $\infty \bar{P}\infty$ : the dome is developed so much as to make the crystals horizontally prismatic, the prism is only slightly developed, and the pyramid  $\bar{P}\frac{1}{2}$  does not occur. Watts also says it "exhibits very distinct cleavage." This cleavage plane I find to be  $\infty P$ , and I also find that the sodium and the silver dithionates exhibit very distinctly this cleavage.

Form.	Angle.	Calculated.	Found.
P	B	125 30	125 23
	C	79 48	79 46
$\infty P$	W	88 55	89 1
$\bar{P}\infty$	W	61 39	61 41

This sample contains per cent Ag 32.0.

$\text{AgNaS}_2\text{O}_6\text{Aq}$  requires per cent Ag 33.0.

**Potassium Trithionate**,  $\text{K}_2\text{S}_3\text{O}_6$ .—The following are the statements regarding the crystalline form of this salt:—Gmelin gives two: (1) "Slender four-sided obliquely truncated prisms (Plessy, *J. für Prakt. Chem.*, 33, 348)," (2) "Right rhombic prisms, with dihedral summits resting on the acute lateral edges (Provostaye, *N. Ann. Chim. Phys.*, 3, 354)." According to Watts it forms four-sided

prisms, bevelled with two faces; and according to Miller it crystallises in the rhombic system, prismatic type with dihedral summits. I obtained it in rhombic needles of  $\infty P$ , with the acute edges modified by another prism,  $\infty \bar{P}_2$ ;  $\infty \bar{P}\infty$  and  $\infty \bar{P}\infty$  are also present; they are terminated by a brachy-dome. Some of the crystals taper like a sewing-needle—I suppose through the presence of a very acute pyramid. I find the axes to be—

$$\bar{a} : \bar{b} : c = 0.3586 : 1.0000 : 0.4204,$$

and the observed forms are  $\infty P$ ,  $\infty \bar{P}_2$ ,  $\infty \bar{P}\infty$ ,  $\infty \bar{P}\infty$ ,  $\bar{P}\infty$ .

Form.	Angle.	Found.	Calculated.
$\infty P$	W	39 31	39 28
$\infty \bar{P}_2$	W	71 12	71 18
$\bar{P}\infty$	W	45 37	45 37

This salt is prepared by acting on a saturated solution of potassium thiosulphate with  $SO_2$ . Now, as it is not stated that sodium thiosulphate will not similarly yield sodium trithionate, nor any reason given why it should not, I attempted to prepare sodium trithionate in this manner, but only obtained crystals of sodium thiosulphate. Rathke (*Journ. pr. Chem.*, 95, 13) prepares sodium trithionate as a white powder by decomposing potassium trithionate with sodium tartrate.

## CORRESPONDENCE.

### SPECIFIC GRAVITY APPARATUS.

To the Editor of the Chemical News.

SIR,—The apparatus described by Mr. J. Taylor (*CHEM. NEWS*, vol. xxxvi., p. 168) is somewhat older than your correspondent P. H. makes out, and has a little history of its own. It appears to have been discovered by Dr. Hare, the American chemist and physicist, and described in *Silliman's American Journal* (vol. xi., for 1826). I have not been able to see this Journal, but in the *Quarterly Journal of Science and Arts* (vol. xxi., p. 384, 1826) a description of it is quoted from *Franklin's Journal*. Sir James Murray re-invented it in 1843 (*Mechanics' Magazine*, January 13th, 1844), and Mr. Ham again invented it in 1844 (*Chem. Gaz.*, ii., p. 125). As a specific gravity apparatus it has little worth, but perhaps Dr. Hare's original one is the best in detail, as described in par. 407 of Bird and Brookes (5th ed., 1860).—I am, &c.,

C. O'N.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 16, October 15, 1877.

**Non-Transparence of Incandescent Iron and Platinum.**—G. Govi.—In a paper in the *Comptes Rendus* of 1867 (lxiv., p. 778) is found an account of a series of experiments, according to which iron, even of the thickness of 5 m.m., became transparent if heated almost to whiteness. The author seeks to connect this transparence of ignited iron with the phenomena of dialysis, which take place through strongly heated metals. M. Govi does not see any connection between the phenomena of osmose and the transparence of substances, and finds experi-

mentally that iron and platinum, even in thin layers and heated to whiteness, are impervious to light.

**Use of Lime-Water to Fix the Fatty Acids in Water used to Feed Steam Boilers.**—M. Hétet.—The author states that oil introduced into steam for the lubrication of the cylinders, &c., are there decomposed into fatty acids and glycerin. Being carried along to the condenser these products of decomposition finally reach the boilers, where they accumulate, and the water of the boilers soon becomes an emulsion of fatty acids. These acids soon attack the boiler-plates, forming enormous black deposits, mixtures of iron soaps, and oxide of iron in variable proportions, which adhere to the surface of the metal and form dangerous incrustations. To obviate these evils the author treats the feed-water before it enters the boilers with lime-water, so as to render it neutral or slightly alkaline.

**Formation of Allylen at the Expense of Bromo-citra-pyro-tartaric Anhydride.**—E. Bourgoin.—If the anhydride above mentioned is dissolved in water and the solution neutralised with ammonia, nitrate of silver gives a precipitate, which disappears on ebullition, but which becomes permanent and very copious under the influence of an excess of the reagent. This salt if suspended in water is easily decomposed and blackens on ebullition. On heating it for some hours to 130° in a sealed tube a large quantity of gas escaped when the tube was opened, which proved to be a mixture of allylen and carbonic acid.

**On Dibromomethyl-carbylamin.**—M. Tcherniak.—This compound may be regarded as cyanate of ethyl, the oxygen in which has been replaced by bromine.

**Researches on Vegetable Gluco-genesis.**—V. Jodin.—Most, if not all, of the higher vegetables contain saccharine matter diffused in their organs. This saccharine matter is generally a mixture of saccharose and of inverted sugar. The amount of sugar is generally smallest in the leaves, and reaches its maximum in the flowers, fruits, stems, and roots, which possess the chlorophyllic function transitorily or but in a slight degree. The slight proportion of sugar in the leaves is, however, no direct proof against the production of sugar by these organs. On the other hand, the constant presence of sugars in all the fungi appears to prove manifestly the mutual independence of the glycogenic and of the chlorophyllian functions. These two functions are found in juxtaposition in the green leaf without the existence of any relation of immediate causality between them.

**Detection of Fatty Matters Fraudulently Introduced into Butter.**—C. Husson.—Natural butter is known to be of good quality by treating a given weight with 10 parts of a mixture of equal volumes of ether at 66° and of alcohol at 90°. The solution is effected by placing the mixture in the water-bath at the temperature of 35° to 40°, and then letting it cool down to 18°. After twenty-four hours genuine butter should leave a deposit of pure margarin, which must not exceed 40 per cent nor fall below 35. An increase in this figure proves sophistication by means of tallow, whilst a decrease shows the presence of "margarin Mouries," of lard, or of goose-grease.

No. 17, October 22, 1877.

**Modifications effected in the Conditions of the Maxima of Electro-magnets by the more or less Complete State of Magnetic Saturation of their Magnetic Nucleus.**—M. Th. du Moncel.—Not suitable for abstraction.

**Experiments relative to the Formation of Ultramarine.**—M. J. F. Plicque.—The majority of the hypotheses which have been framed concerning the chemical constitution of ultramarine are based upon analyses executed with products obtained industrially. The centesimal composition of the substances reacting is always rigorously determined, but as during this manufacture a part only of the components serves to produce

ultramarine, whilst the remainder yields soluble products, ultimately eliminated by washing; as, further, the proportions of silica and alumina may vary in the mixtures without the blue colour being sensibly affected, the analytical results are so complex that it is difficult to deduce from them a rational formula. The author has sought to realise the synthesis of ultramarine by a laboratory method which would enable him to employ chemically pure silica, alumina, soda, and sulphur in the formation of the blue colour. On examining in what proportion the silica, alumina, and soda should combine, he observed that the insoluble alumino-silicate of soda obtained by Deville presents the same proportions of silica and alumina as the mixtures employed in certain establishments for the production of blue ultramarine. This silico-aluminate of soda contains 44.6 of silica, 26.4 of alumina, 16.3 of soda, and 12.7 of water. The ratios of oxygen are as 6, 3, 1, 3. On heating it for thirty hours in a muffle with 25 per cent of sulphur and 2 per cent of resin, an ultramarine of a perfect shade is obtained. In order to examine the different reactions produced, the author operated in the following manner:—Silicate of soda prepared with pure materials, and aluminate of soda likewise pure, were mixed in equivalent solutions. The product obtained on collecting the precipitate upon a filter, and drying rapidly at 110°, always contained an excess of soda, and presented the following composition:—

Silica	..	..	..	31.105	31.150
Alumina	..	..	..	18.402	18.410
Soda	..	..	..	29.367	29.359
Water	..	..	..	20.750	20.749
				99.624	99.688

The material employed in these experiments contained therefore 60.86 per cent of the silico-aluminate of soda, in which the ratios of oxygen are 6.3.1. Upon this molecule ( $3\text{SiO}_2\text{Al}_2\text{O}_3\text{NaO}$ ) he caused to react sulphuretted hydrogen and sulphurous acid at the temperature of dull redness, about 750°. He also used sulphide of carbon in place of sulphuretted hydrogen, and by operating for several days he hoped to obtain the crystalline ultramarine of MM. G. Grunzweig and R. Hoffmann. 100 parts of silico-aluminate of soda heated for ninety hours in the vapour of carbon bisulphide yielded 96.840 of a sulphuretted product, white, slightly yellowish, which on exposure to moist air absorbs oxygen with rapidity and becomes bluish, sulphuretted hydrogen being developed at the same time. This 96.840, heated for ten hours in sulphurous acid until the weight became constant, gave 107.6 of ultramarine-blue, the sulphurous acid being absorbed in very large quantity; and during this second stage of the operation a large proportion of sulphur was evolved and deposited in the colder parts of the porcelain tube. The blue thus produced at the temperature of about 750° contains no free sulphur, but 41.3 sulphate of soda, which can be eliminated by washing with boiling water. No soluble sodium sulphide could be detected. This ultramarine, when carefully washed with distilled water, was of a very deep and pure blue, but did not present the violet tone of the ultramarines of commerce. Its composition was found to be as follows:—

Silica	..	..	..	46.810	$3\text{SiO}_3$
Alumina	..	..	..	27.702	$\text{Al}_2\text{O}_3$
Soda	..	..	..	17.280	$\text{NaO}$
Sulphur	..	..	..	5.217	
Oxygen	..	..	..	2.991	cal. as loss.
				100.000	

On examining these figures we see that the silica, alumina, and soda found in the blue are still in the same proportions as in the insoluble silico-aluminate of soda. The excess of soda contained in the precipitate employed has been entirely converted into sulphate of soda. The author not having succeeded in obtaining crystallised ultramarine, has not been able to assign a formula to this

compound, but he infers from his experiments that:—Contrary to the assertions of certain German authors, ultramarine contains no nitrogen. Blue ultramarine, properly so-called, is formed by an oxy-compound of sulphur, which is probably fixed both upon the sodium and the aluminium. During the first period of the operations, the passage of the sulphide of carbon, the sulphur is substituted for a part of the oxygen in the molecule of the silico-aluminate of soda, and in the excess of soda it completely replaces oxygen. The sulphurous acid, reacting upon this first compound, takes the place of a part of the sulphur of the molecule of the sulphuretted silico-aluminate of sodium, and destroying the sodium sulphide not chemically combined with silica and alumina, converts it into sulphate of soda. To obtain these results it is necessary to keep the materials for several days in the vapour of carbon bisulphide at 750°. If the temperature is raised to 1000° we obtain a black agglomerated product, which on treatment with water evolves sulphuretted hydrogen, and is transformed into ultramarine-blue. This product evidently contains Fremy's aluminium sulphide, and this experiment renders it conceivable that a part of the sulphur in ultramarine may be found in the state of aluminium oxy-sulphide. If instead of sulphuretted hydrogen and sulphurous acid we use seleniuretted hydrogen and selenious acid, a red compound is produced analogous to the blue, whilst tellurium similarly applied gives a yellow product.

Catechins and their Constitution.—M. Arm. Gautier.—Not adapted for abstraction.

Acid Acetates.—M. A. Villiers.—The existence of acid acetates, or at least of anhydrous acid acetates, might be foreseen from the study of the tensions of dissociations. In fact, neutral acetates placed in contact with the vapour of acetic acid behave in the same manner as salts capable of forming hydrates when brought in contact with watery vapour.

Researches on Butylen and its Derivatives.—M. E. Puchot.—Butylen is soluble in 10 parts by weight of water; acetic acid (monohydrated) dissolves 62 times its own volume. The specific gravity of butylen in the gaseous state is approximately equal to 2°. Butylen is a liquefiable gas. The liquid boils at  $-4^\circ$ ; its specific gravity at  $-13.5^\circ = 0.635$ .

*Revue Universelle des Mines, de la Metallurgie, &c.,*  
July and August, 1877.

Present Condition of the Zinc and Copper Industries of the United States.—J. Beco.—There are two zinc-mining districts in America, that of the east comprising Pennsylvania, New Jersey, New York, and Virginia, and that of the west between the Alleghanies and the Rocky Mountains. The first discoveries of zinc ore were made as early as the seventeenth century, but it was generally supposed to be an immature lead ore which would be developed in course of time. In 1850 the New Jersey Zinc Company succeeded in obtaining both metallic zinc and zinc-white from the red oxide found in the County of Sussex. The author remarks that hitherto no decisive progress has been effected in the manufacture of pure zinc in the United States.

*Les Mondes, Revue Hebdomadaire des Sciences,*  
No. 6, Oct. 11, 1877.

The "hygroscopic flowers," which change their colour according to the degree of moisture in the atmosphere, and which are supposed to be a modern invention, were suggested by Herbelot in 1737, and were made on a commercial scale in 1792.

No. 7, October 18, 1877.

This issue contains no chemical matter except an account of the scientific labours of the late Prof. Graham.

## MISCELLANEOUS.

**Appointment of Public Analyst.**—William Arnot, F.C.S., Analytical Chemist, Edinburgh, has just been appointed Public Analyst for the Counties of Roxburgh and Selkirk, and the Burghs of Hawick, Galashiels, Selkirk, and Kelso. We observe that Mr. Arnot is to deliver a Course of Cantor Lectures on Paper, at the Society of Arts, during the forthcoming Session.

**Columbium.**—We shall soon hear of columbium-plating, a metal which is very much like nickel, but whiter, like tin. It was first found, more than fifty years ago, in the United States, near Middletown, Conn., and named in honour of America. It was thus far very scarce, but has now been found at Marion, N.C., and also in the Amazon stone of Colorado. If it becomes abundant enough to be used in the arts we may soon have a valuable addition to the useful metals, and also to their compounds or salts. The metal forms an acid like tin, called columbic acid; tin forms stannic acid, and the compounds of this acid with bases are stannates, very useful in the arts; the compounds of columbic acid with bases must be called columbates. They have not yet been investigated, but will likely be found extremely useful for some purposes.—*Manufacturer and Builder*, ix., 183.

## NOTES AND QUERIES.

**Portland Cement.**—Can any correspondent inform me of any work where I can find full information on the manufacture of Portland cement?—A. P.

## MEETINGS FOR THE WEEK.

SATURDAY, Nov. 3rd.—Physical, 3.

MONDAY, 5th.—Royal Institution, 2. (General Monthly Meeting).

## TO CORRESPONDENTS.

*J. McNaught.*—You do not state what sort of oils, &c., you want—whether mineral or not. Send us further particulars and we may be able to give information.

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**GEOLOGY.**—In the Preface to the Student's ELEMENTS of GEOLOGY, by Sir Charles Lyall, price 9s., he says:—"As it is impossible to enable the reader to recognise rocks and minerals at sight by aid of verbal descriptions or figures, he will do well to obtain a well-arranged collection of specimens, such as may be procured from Mr. TENNANT (149, Strand), Teacher of Mineralogy at King's College, London." These Collections are supplied on the following terms, in plain Mahogany Cabinets:—

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# THE CHEMICAL NEWS.

VOL. XXXVI. No. 937.

## REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.\*

By Dr. A. W. HOFMANN.  
(Continued from p. 198.)

*Phosphorus and Matches.* By Dr. ANTON VON SCHRÖTTER,  
Master of the Imperial Mint at Vienna.

For the preparation of phosphorus bone-earth, as already mentioned, is generally employed. It is, however, stated that latterly phosphorites have come into use for this purpose in England, a step which will be ultimately necessitated by the increasing demand for phosphorus, and by the other applications of bones. Already we are compelled to procure from very remote regions this precious and useful material, whose especial destination is to maintain unbroken the circulation of matter; which of course involves a sensible increase in the price.

It is therefore to be lamented that a large quantity of bones remain unutilised for this great purpose from indolence or ignorance, and another from deeply-rooted religious prejudices. Invitations and proposals to obviate these evils have not been wanting, and especially as regards the last-mentioned point, they were to be found at the Exhibition. Thus Cav. Ludovico Brunetti, Professor of Pathological Anatomy at Padua, exhibited an apparatus for the incineration of dead bodies, together with the residue from the combustion of a corpse which had weighed 45 kilos. (No. 4149). The weight of the whitish residue was 1077 grms.; the process of combustion lasted three and a half hours, and the expense was merely 1·2 Austrian gulden.†

The quantity of bone-earth remaining on the incineration of bones varies according to age and to the part of the body to which they belong. On an average it is about 59 per cent. Its composition is:—

Calcium phosphate, $\text{Ca}_2(\text{PO}_4)_2$ ..	85·7
Magnesium phosphate .. ..	1·7
Calcium carbonate .. ..	9·1
Calcium fluoride .. ..	3·0
	99·5

As, however, 100 kilos. of bones yield, at most, 8 kilos. of phosphorus, more than two-thirds of the total amount present in the bones remaining in the residues, it appears that for the production of the quantity of phosphorus required a very considerable amount of bones is required, as shown in the following figures. R. Wagner states in his valuable "Yearly Report" (xi., 267), that in the year 1864 to 1865 the production of phosphorus was:—

	Kilos.
In France and Italy .. ..	100,000
In Germany and Austria ..	90,000
In England .. ..	75,000
	265,000

\* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

† See Brunetti's work "Cremazione dei Cadaveri;" also Dr. J. P. Trusen's "Die Leichenverbrennung als die geeignetste Art der Todtenbestattung," Breslau, 1855; and, finally, an excellent article by Sir Henry Thomson in the *Contemporary Review*, January, 1874, in which the subject is considered from the sanitary and economical points of view. (See *N. fr. Presse F.*, 1874, No. 40). The best success must therefore be wished to the exertions of the recently-formed Cremation Society of Hamburg.

for which 3,312,500 kilos. of bones were required. For the present time these figures are far too low, as will appear from the statistics of the French match trade, as given below.

Hence, it appears that in the preparation of phosphorus as generally carried on a valuable material is consumed in a profligate manner. The endeavours of chemists to utilise it more thoroughly, are, therefore, still continued. On the one hand, the manufacture of animal charcoal or bone-black, an article of great importance in sugar refining, and in many other branches of industry, has been greatly improved, the bones, previously freed from fat, being now heated, not in iron crucibles, but in horizontal cylinders, such as are used in the manufacture of coal-gas.\* As by-products are obtained carbonate of ammonia, the consumption of which is daily on the increase, as also animal tar and a lighting-gas of very good quality. The tar is as yet a mere burden to the manufacturers, since it has not yet been brought into use, and is therefore disposed of by burning, which is not without difficulty. The time is, however, certainly not far distant when a product so rich in basic nitrogenous compounds will find a profitable utilisation.

Where circumstances admit the animal charcoal, after being used for clarification, is incinerated, and the ash is further utilised. Or the recent bones are treated with hydrochloric acid to extract the phosphates, and the residual cartilage is used in the glue manufacture. Upon this H. Fleck founded a very rational process,† which A. W. Hofmann has already discussed in Report, but which does not yet appear to have been universally introduced, though the objections raised on account of the want of suitable vessels for the evaporation of the lyes might not be insuperable.

Similar has been the fate of Metrand's ingenious proposal to act with hydrochloric acid gas upon an intimate mixture of equal parts of bone-ash and wood-charcoal, thus obtaining phosphorus, a method also mentioned by Hofmann. Instead of bone-ash a natural phosphate might serve, or one prepared by precipitating the hydrochloric solution of bones with lime. The chloride of calcium thus obtained could be used without difficulty for the reproduction of hydrochloric acid, so that the final result would be sulphate of lime containing a small proportion of phosphates, which might be very well utilised as manure.

Recently the process suggested years ago by Wöhler to decompose phosphate of lime with silica and carbon has been carried out on the large scale at Coignet's works in Lyon, having been re-discovered by Aubertin and Robiquet.‡ We must not forget that Brand first obtained phosphorus by distilling urine previously evaporated to dryness with sand.

Brisson has modified Wöhler's process by adding soda to the above-mentioned mixture, and heating in a shaft-furnace. The operation must be managed in such a manner that the liberated phosphorus may not come in contact with the air, which is not very easily arranged.§

In England sombreroite, which is found abundantly in the Antilles, and especially in the island of Sombrero, is said to be used for obtaining phosphorus. It consists of 49·6 phosphoric acid, 42·7 lime, 6·5 alumina, and 1·1 moisture.||

Another West Indian mineral known as Redonda phosphate is used in England, consisting chiefly of alumina and phosphoric acid, along with some iron. Spence opens up the mineral, after ignition and pulverisation, by boiling with sulphuric acid. By the introduction of ammonia

\* G. Lunge's description of the process of bone-distilling introduced in England. *Wagner Jahresber.* 1867, 199; *Dingl. Pol. Journ.*, clxxxiv., 513.

† "Verbessertes Verfahren der Phosphor Fabrikation." Hugo Fleck. Leipzig, 1855. See *Wagner Jahresber.*, 1855, 66.

‡ *Moniteur Scientif.*, 1869, 173.

§ *Wagner Jahresber.*, 1869, 223.

|| *Wagner Jahresber.*, 1862, 247. An attempt has also been made to use phosphate of iron instead of phosphate of lime in the preparation of phosphorus. Details are not known and success is improbable.

from gas-liquors ammonia-alum is formed and readily removed by crystallisation. The mother-liquor contains principally phosphate of ammonia, which may be used in the manufacture of manure.

Gerland extracts bones, previously deprived of fat, with sulphurous acid, and heats the solution when the phosphates are deposited, whilst the acid escapes and may be re-used.\* This process appears to be in use in France, where patents for its execution have been taken out by several manufacturers.†

As far as the reporter is aware the total supply of phosphorus is furnished at present by two establishments only; the firm of Albright and Wilson, of Oldbury, near Birmingham, and by Coignet and Son, of Lyon. O. Pauli, who formerly managed the works of Schattenmann, at Buxweiler, near Strasburg, produced there, and subsequently in his own manufactory at Karlsruhe, phosphorus of excellent quality, and employed Seubert's ingenious process for drawing the product into rods. According to recent intelligence the manufacture there has been abandoned, and in general no phosphorus is produced in Germany, a fact evidently depending on the price of the raw material.

In Austria, also, phosphorus is at present no longer produced. Ploy formerly fitted up a manufactory at Obernberg, in Upper Austria, and, subsequently, in 1849, at Manning, in the same province; but the production, which amounted to 250 cwts. annually, ceased in 1865. Another establishment was opened in 1853 by Baron Riese-Stallburg, at Wranowitz, in the circle of Pilsen, in Bohemia, where about 180 cwts. of phosphorus were yearly produced. This manufactory also was discontinued in 1865.

The firm of J. D. Stark, who, in 1847, introduced the manufacture of phosphorus on the large scale at their works at Kasnau, in Bohemia, have also abandoned it in 1868. In a pamphlet issued by opportunity of the Exhibition under the title "The Firm J. D. Stark, their Mines, and Manufactories of Mineral," compiled by A. Prochaska, manager of the works at Kasnau, the reason alleged was the high price of bones, due to the great development of the sugar manufacture in Austria, and especially in Bohemia, and to their consumption in agriculture both as bone-dust and in artificial manures. A second reason why the establishment could not compete with England in the price of phosphorus might possibly be found in the circumstance that Messrs. Stark obtained from 25 to 26 cwts. of bones only 1 cwt. of phosphorus, *i.e.*, 4 per cent, while in England 8 per cent are extracted. The cause of this loss was that the gases on their exit from the retort had to overcome a pressure, which, though slight, was sufficient to facilitate the escape of the vapour of phosphorus through the porous sides of the retort.

The applications of phosphorus are so numerous that it is scarcely possible here to enumerate them all. Its greatest consumption by far is in the manufacture of matches. But it is difficult to form a correct estimate of the extent of this application. If we take as a basis the statements *Compagnie Generale des Allumettes Chimique*, according to which the consumption in France is 360 tons, and if we assume that in the rest of Europe only double the quantity is used for the same purpose, it appears that the match trade requires the serious amount of 1080 tons, = 1,080,000 kilos. This calculation, however, is merely approximate. Nor are we able to check it either by the number of matches yearly produced or by the quantity of the inflammable mass used in their preparation, since both these factors are unknown. As regards the amount of the inflammable mixture especially accounts vary very widely, its proportion of phosphorus being given as low as 6 and as high as 40 per cent. Thus, according to M. Hochstätter, of Langen, 15 grms. of mass containing 7 per cent of phosphorus suffice for 1000 matches, whilst according to M. Pollak, 31 grms. of a mass with the

same percentage of phosphorus are required for the same. These discrepancies are intelligible if we consider the different sizes of the matches and the unequal bulk of their heads. As to the above-mentioned quantity of 1080 tons of ordinary phosphorus the amorphous must be added, which is now consumed to a not inconsiderable extent for the Swedish safety-matches, and also the consumption for other purposes, the amount of phosphorus yearly required may be estimated at 1200 tons, for the production of which 15,000 tons of bones are consumed if the yield is assumed at 8 per cent.

*The Match Trade.*—No fewer than 40 firms exhibited matches at Vienna, but not one of them has produced any decided novelty. The attempts of manufacturers have been almost exclusively directed to a pleasing appearance, the increase of production, and the reduction of price. The great bulk of matches are still made with ordinary phosphorus. Next in number, though at a great distance, follow those which can be struck only on a peculiar surface prepared with amorphous phosphorus.

Matches tipped with a mixture containing amorphous phosphorus, and capable, therefore, of being ignited on any surface, were exhibited only by one firm, H. Hochstätter, of Langen, near Frankfurt on the Main.

Matches of this kind were even displayed at the London Exhibition of 1851, but met with no approval as they were not easy to strike, and their ignition was often attended with a slight explosion and the projection of sparks. The matches of this kind exhibited by the Viennese firm of Forster and Wawra at Paris, in 1867, still suffered from the same defects, though in a smaller degree.\*

H. Hochstätter has finally succeeded in the complete solution of the problem, which the present reporter attempted twenty-six years ago, as may be seen from the report on the matches displayed in the London Exhibition of 1872, to which he therefore refers.†

(To be continued.)

## ALUMINIUM PLATE AS A SUPPORT IN BLOWPIPE WORK.

By W. M. HUTCHINGS.

THOSE who are in the habit of using the blowpipe, either for the determination of minerals or for the preliminary examination of substances for detailed analysis, will be well aware how difficult it is to obtain suitable pieces of charcoal for sublimates, and how expensive they are even when they can be got at all. They are also very bulky and inconvenient to carry when one wishes to use blowpipe apparatus in travelling.

For these reasons various suggestions have been made for economising and partially replacing them. Foster introduced a slab of unglazed porcelain, of the size and shape of a good piece of natural charcoal, having at the ends cavities into which fit small pieces of charcoal on which to place the assay. The surface of the porcelain is blackened by holding it down into the flame of the lamp, and receives the sublimates in the same manner as a long piece of charcoal. This answers the purpose very well, and a piece of charcoal which by itself would only

\* The firm of B. Forster and F. Wawra is, since 1871, known as F. Wawra and A. Kempny. It is unfortunate that this firm, one of the oldest in Austria and the direct successor of Th. Preschel, did not exhibit. The works occupy a surface of 2381 square metres, employ 160 persons, and produce yearly 2500 millions of matches. The dextrin required in the mixture is made on the premises. The establishment has ceased making matches with amorphous phosphorus, as the demand was insufficient.

† Space does not allow of a repetition of the history of the match trade. It may be found in A. W. Hofmann's "Report" for 1862, that of the writer for the same occasion; in the copious "Report" of Dr. Holdhaus on matches in the Paris Exhibition of 1867; and in the "Report" of the General Direction on Matches and Explosives at the Vienna Exhibition of 1873. See also Thiel's paper in *Wagner's Jahresber.*, 1866, 747.

\* *Bul. Soc. Chim.*, ii., 1864.

† *Zeitschr. f. Ch.*, 1870; *Journ. f. Prakt. Ch.*, iv., 67, 1870.

serve a few times, with the trouble (and dirt) of cleaning the used surfaces with a rasp, will cut up into a large number of the small pieces required on this support.

Mr. Fletcher, of Warrington, suggested to me the use of porcelain plates having a small ledge at right angles for the support of a bit of charcoal, so held that the blackened surface for receiving sublimates should be almost vertical, after the manner of the aluminium plate introduced by Major Ross. This would be better than either long pieces of charcoal or Foster's support, as it is undoubtedly far preferable to catch the sublimates on a vertical, or almost vertical, surface.

But by far the best support, in every way, is the above-mentioned aluminium plate just used by Major Ross, and described by him in his book "Pyrology." Having worked for some time with this, and after long and careful trials, and comparisons with charcoal, having found it so very excellent and useful, I think some remarks on it may be of service to those who have not yet tried it. I have reason to believe that its use is still very little known, and it is certainly a pity that anybody should continue using charcoal when there is something so much superior to be had. Probably many people, like myself, when they first read about it, were incredulous as to a piece of polished aluminium-foil being suitable for the purpose, or were alarmed at the rather elaborate polishing and burnishing during use which Ross directed to be applied; and so stuck to the old charcoal or the porcelain substitute. But it is a fact that the aluminium *does* stand the work perfectly; and in practice, after once polishing the new plate, all the cleaning required is done in half a minute with a bit of wash-leather and some fine-ground bone-ash and water. In many cases just the wet leather is sufficient.

I propose in the following notes to point out some of the advantages of aluminium-plate as observed during my own work, and finally to give a list of sublimates of those metals the behaviour of which on charcoal is given in Prof. Richter's edition of Plattner. Most of this is simply confirmatory of the descriptions given by Major Ross in his book and elsewhere, the only value consisting in the fact of those now given being from a careful lot of independent observations, and in their being drawn together into a systematic list, which will be of use to anybody who may wish to try the aluminium for the first time, and may not be valueless even to those who already use the method, but who have not troubled to make out a complete table of results.

The plate is not only a great gain as to portability, cleanliness, and expense, but also gives, in most cases, much better indications of the volatile substances sought for.

The only charcoal required with it is a stock of small pieces, about half an inch square and rather thicker than a penny-piece, which can easily be cut ready, and, if necessary, carried in large numbers. The best aluminium for the purpose is about the thickness of a sixpenny-piece. A strip of such foil should be got, 5 inches long by  $1\frac{1}{2}$  inches wide, and one end should be turned up to form a ledge, as directed by Ross, this ledge being between  $\frac{1}{2}$  and  $\frac{3}{4}$  inch wide, and making rather less than a right angle with the rest of the plate. Sheet-aluminium, even of much greater thickness than this, can be bent easily without any cracking by heating it in a Bunsen burner and working it while hot. It can be had of any thickness and dimensions required, of Messrs. Johnson, Matthey, and Co., for 7s. 6d. per ounce. After turning up the ledge, and rounding off the edges and corners with a file, the plate should be well scoured with bone-ash and polished with leather and whiting.

When in use it is best held with the spring-forceps described by Ross, though other forceps can be made to serve the purpose, the handles being covered with felt or flannel, as they get very hot. It is held so as to be almost vertical—only just enough inclined to prevent the assay and the slip of charcoal from falling off the ledge. A

little practice enables the worker to hold it quite steadily, with as much ease as he does the ordinary piece of charcoal.

Such a plate will cost about 3s. 6d., and will last any length of time. The blowpipe-flame does it no injury (not even a good powerful one worked by a small hand-blower), and there is scarcely any substance which may not be heated directly upon it with perfect safety. The one side being kept for sublimates, the other may be used for such purposes as calcining sulphides, &c., before testing in beads, for which it is far superior to charcoal, especially in the case of very fusible minerals.

The principal advantages of the aluminium are—

1. It enables us to get several sublimates in succession from the same fragment of substance. Heated very gently on the bare plate, only the most volatile constituents are given off. As the heat increases more and more is given off, but a limit is reached beyond which nothing is obtained, the less volatile constituents not being given off at all, or only very slightly, as long as the substance is cooled by lying direct on the aluminium. The same fragment being then placed on a slip of charcoal on the ledge, these less volatile constituents are obtained in the separate sublimate.
2. The sublimates are mostly much more concentrated on the aluminium as compared with ordinary charcoal, which, when exposed to the flame for any length of time, gets red-hot a long way in front of the assay. The aluminium remains comparatively cool; and the vertical surface prevents the sublimates being swept along by the blast so much as on the nearly horizontal charcoal.
3. When the sublimate is once formed the aluminium has no further action upon it, and many very characteristic changes may be observed by applying an oxidising or reducing flame, most of which cannot be obtained at all on charcoal, partly because its being black would hide them, but chiefly because it immediately begins to glow under the sublimates when the flame is applied to them.

The best way to work is as follows:—A fragment of the substance, about half the size of a small pea,—or, if it decrepitates, a corresponding amount of powder made to a paste with water,—is laid upon the ledge close up to the angle, and heated very slightly, about half an inch from the tip of a pure blue flame, with gentle blast, which is blown down on to the assay at a rather steep angle. Any sublimate obtained should be examined from time to time, the heat being increased after each examination, till finally very little or nothing more is obtained. The sublimates are then cleaned off, the same fragment of substance is placed on one of the slips of charcoal, in a small cavity in its centre, and again gradually heated and the sublimate examined as before, till finally, in the strongest heat, nothing more is given off. The flame should always be so applied that its tip does not come nearer than half an inch to the assay as long as any sublimate is obtained, and only in cases where nothing is given off should it be brought so that the tip of the blue cone covers the assay. The reason for this is, that some of the sublimates are so very susceptible of reducing action that if the flame were brought up too close they would be altered before they could be observed.

If no sublimate is obtained, either in the O.F. or in the blue tip, the powdered substance should be mixed with its own bulk, or rather more, of sodium carbonate, and the paste heated on charcoal-slip within the blue tip.

Whenever a distinct sublimate has been obtained the assay is removed from the paste, and further examination made as follows:—

1. The sublimate is held about  $1\frac{1}{2}$  inches in front of a pure and moderately strong flame, and the behaviour of its various portions noted. This is what Ross calls the "peroxidising pyrocone." It produces many effects of oxidation which cannot be obtained

in what is usually termed the "oxidising flame," closer to the tip of the blue. As it would be convenient to have a special name for it, it might be called the "peroxidising flame" (preferring our old and short friend "flame" to "pyrocone"), and have the symbol P.F.

2. The sublimate, after the application of P.F., is brought up so that the tip of the blue cone flattens against it on the plate, and the behaviour of the various portions again noted. Only a very pure flame is of any use for this, as the least streak of yellow in it causes instantly a sooty mark, which might be mistaken for some of the reductions produced; though such sooty marks are distinguished by their instant disappearance in O.F.

(To be continued.)

### THE GRAHAM-BELL TELEPHONE.

ON the 31st of October Prof. Graham Bell read a most interesting paper on his Articulating Telephone before the members of the Society of Telegraphic Engineers, Prof. F. Abel, C.B., F.R.S., the President of the Institute, being in the chair.

Prof. Bell commenced his paper by giving an account of the manner in which he was led to the study of the question of the transmission of the human voice to a distance by electricity, through having to make a number of experiments on the human voice for his father, Prof. Melville Bell, the inventor of the system of Phonetics known as Visible Speech. While prosecuting these researches he was led to repeat Helmholtz's experiments on the measurement of the number of vibrations giving rise to the vowel sounds, by setting reeds in motion by electrical currents. The idea at once occurred to him that if he could transmit vowel sounds through a few inches of wire they might also be sent to a distance of several miles, and that the principles which applied to vowels applied with equal force to consonants. After much patient experiment Prof. Bell was at last able to converse freely with his assistant, at a distance of several hundred yards, by means of an ingenious but exceedingly complicated piece of apparatus.

The lecturer next described how he threw away first a lever, then a reed, next a battery, until finally—by descending steadily from complexity to simplicity—he has reduced the articulating telephone to its simplest expression. The very last portion of the apparatus discarded was the soft iron keeper attached to the attracting end of the magnet. In the latest form of instrument the magnet attracts the diaphragm direct, without the intervention of any armature. As it stands, the instrument could hardly be more simple than it is; in fact it is difficult to believe—except from actual optical and aural observation—that a magnet as thick as one's thumb and twice as long as one's finger, a coil of covered wire, and a diaphragm of iron a little larger than a crown piece, are all that is necessary to convey distinct articulate sounds to remote distances. The Graham-Bell telephone, as manufactured by the Silvertown Gutta-percha and Telegraph Company under the direction of Prof. Bell, may be carried in one's trousers pocket. It consists of a cylindrical steel magnet, 6 inches long, fixed into a wooden case; on the attracting end of the magnet is a coil of covered wire, the terminals of which are connected with a corresponding coil on the twin instrument. A diaphragm of soft iron, as thick as a piece of cheap note-paper, is fastened on the open end of the mahogany tube at an infinitesimal distance from the magnet, an ordinary wooden mouth-piece being screwed on over all.

Prof. Bell's lecture was listened to with marked attention by a crowded and distinguished audience, who frequently interrupted the speaker with loud bursts of applause. Incidentally Prof. Bell mentioned some singular facts with regard to the working of the telephone

which he candidly acknowledged he could not explain; for instance, absolute insulation does not seem necessary, for he had transmitted sounds through a line of railway metals which were far from being in continuous contact. Strangely enough the sounds were continually confused by the action of a telegraph-wire 40 feet off, through which messages were constantly passing. Another instance of the extreme sensibility of the telephone to external disturbances came under the observation of Prof. Channing, of Brown University, Providence, Rhode Island, whose private house is joined to the College by about a mile of well-insulated wire. While communicating with his assistant, they both heard distinct sounds of singing passing through the instrument. To the songs succeeded piano-playing, the whole of the sounds being so distinctly conveyed that the Professor took a list of the pieces which were sung and played. Next day he advertised the list in the Providence papers, requesting information as to the exact house in which the performance took place, so that he might investigate the matter fully: his letter to Prof. Bell was, however, despatched before the desired information had arrived. With respect to the vibration diaphragm it was at first supposed that very thin iron leaf must be used, but Professor Bell has transmitted sounds with equal facility by using a diaphragm of boiler-plate three-eighths of an inch thick, and 12 inches in diameter. From this singular circumstance he infers that the diaphragm does not vibrate in mass, but that the motion set up is purely molecular. This fact, and the inference deduced from it, opens up a vista of speculation as to the nature of sound, into which it would be out of place to enter here; we confine ourselves, therefore, to stating the fact. Professor Bell also described how a telephone could be worked without the intervention of a permanent magnet at all by employing a soft iron rod suspended in the magnetic meridian and the line of dip. This, we believe, is the first time in which the force of the earth's magnetism has been used to convey messages to a distance. In practice it is, of course, much more simple to use a permanent magnet. A musical telephone was also exhibited, but as it has not yet passed beyond the experimental stage it would be unfair to criticise its performance.

After the lecture Colonel Rennel descended to the basement, and kept up a lively conversation with Prof. Abel, Prof. Stokes, Messrs. Latimer Clark and Preece, and several other well-known electricians, all of whom declared that they heard everything perfectly, and gave Colonel Rennel's answers to the questions put to him *viva voce*. The latest telegrams were also read by Prof. Bell's assistant in the basement, and repeated to the audience by the President.

On the proposition of Mr. Latimer Clark, seconded by Mr. Preece, a vote of thanks was carried to Prof. Bell by acclamation.

In the course of his lecture Prof. Bell mentioned a curious instance of the *misuse* of the imagination in matters of science. When his first instrument for the transmission of articulate sounds was, as he thought, perfect, he put the question to his assistant, "Do you hear what I say?" The answer that Professor Bell heard was "Perfectly?" but on afterwards comparing notes it was discovered that neither had used the words that the other had heard, or, to put it more plainly, each had heard exactly what he expected to hear and not what the other had said.

### PROCEEDINGS OF SOCIETIES.

#### CHEMICAL SOCIETY.

Thursday, November 1, 1877.

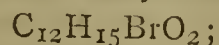
Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

The minutes of the previous meeting were read and confirmed. The list of presents to the library was read, and

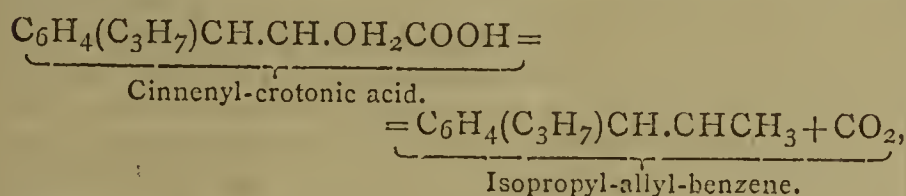
the thanks of the Society given to the respective donors. The following certificates were read for the first time:—W. J. Williams, W. D. Harland, A. H. Elliott, H. R. Hind, H. B. Nason.

The following papers were communicated to the Society:—

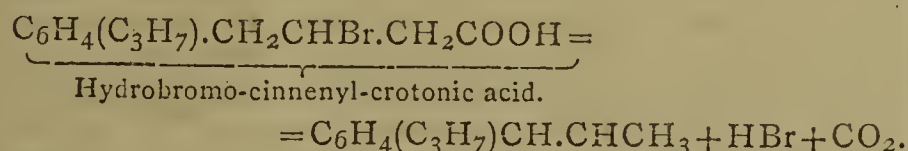
"On some Hydrocarbons Obtained from the Homologues of Cinnamic Acid, and on Anethol and its Homologues," by W. H. PERKIN, F.R.S. (a.) Considerable quantities of cinnenyl-acrylic, crotonic and angelic, and phenyl-crotonic and angelic acids were prepared. The hydrocarbons were at first obtained by decomposing the acids by heat, afterwards the process proposed by F. Binder, viz., treating the hydrobromo acids with bases was found to yield more satisfactory results. A solution of hydrobromic acid in glacial acetic acid instead of an aqueous solution answered very well. The following acids were prepared and examined:—Hydrobromo-cinnenyl-acrylic acid,—



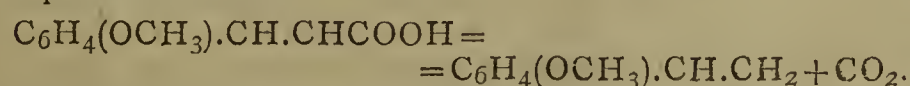
fuses 85° to 87° C. Hydrobromo-cinnenyl-crotonic acid,  $C_{13}H_{17}BrO_2$ ; crystallises in flat oblique prisms, fuses at 148° to 150° C.; on further heating HBr is evolved. Hydrobromo-cinnenyl-angelic acid,  $C_{14}H_{19}BrO_2$ . All these hydrobromo-acids, when treated with a cold solution of sodium carbonate or potassium hydrate, decompose, hydrocarbons being produced as follows:—Isopropyl-vinyl-benzene boils at 203° to 206° C.; sp. gr. at 15° 0.8902; heated for a few hours to 150° C. it solidifies to a transparent glassy mass. This change also takes place slowly at ordinary temperatures in daylight. The properties and chemical reactions of this substance are given. The dibromide was prepared, fusing at 71°. Isopropyl-allyl-benzene boils at 229° to 230°; sp. gr. at 15° 0.890; does not solidify at -15° C.; its formation may be represented thus:—



or—



Its dibromide was obtained by shaking the hydrocarbon with bromine. It melts at 59° to a colourless oil, crystallising beautifully on cooling. Isopropyl-butenyl-benzene is a colourless oil, boiling at 242° to 243°; its sp. gr. at 15° is 0.8875. It resinifies if kept in contact with the air; its dibromide was prepared melting at 77°. Allyl-benzene boils at 174° to 175°; sp. gr. at 15° 0.9180; when heated between 160° to 200° for sixty hours it did not undergo any visible change; its dibromide was obtained as a crystalline mass, fusing at 67°. Butenyl-benzene, a colourless oil, boiling at 186 to 187° C.; a dibromide was prepared crystallising in needles, melting at 67°. The two last-named hydrocarbons have already been obtained. Allyl-benzene by L. Rügheimer (*Journ. Chem. Soc.* p. 894, 1874); it has the same constitution as the body prepared by the author. The butenyl-benzene, however, prepared by B. Aronheim (*Deut. Chem. Ges. Ber.* v., 1068), is isomeric with the one now produced. (b.) On gently boiling methyl-paroxy-phenyl-acrylic acid an oil gradually distils over, having a fennel-like odour. This body, after purification, had the formula  $C_9H_{10}O$ ; the author proposes to call it vinylic-anethol; it boils at about 201° to 202°, melts at about -1° to -2°. Its formation may be represented thus—



An endeavour was made to prepare this substance Binder's reaction, but without success. On heati

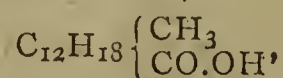
methyl-paroxy-phenyl-crotonic acid an oil distils over carbonic acid being evolved; by fractional distillation freezing and pressing the mass thus obtained between blotting-paper perfectly pure allylic or ordinary anethol was obtained, identical with that obtained from oil of anise. By heating methyl-paroxy-phenyl-angelic acid, butenyl anethol is obtained in an impure state, but by treating the hydrobromo-derivative of that acid with sodium carbonate, &c., perfectly pure butenyl anethol is obtained; it is crystalline, fusing at 17° C., boiling at 242° to 245°; sp. gr. at 30° 0.9733; formula  $C_{11}H_{14}O$ . In conclusion the author discusses the formation of the hydrocarbons from the hydrobromo-acids by heating with sodium carbonate; he finds that silver nitrate in aqueous solution, sodium acetate, and, in some cases, even water, may be substituted for sodium carbonate, and yet the hydrocarbon be formed, and concludes that the hydrocarbons are formed simply by the separation of hydrobromic acid and carbonic anhydride. The author remarks that only the hydrocarbon and anethol containing vinyl polymerise when heated, and form compounds corresponding to meta-cinnamene; also their boiling-points differ much more from those of the compounds containing allyl than do the latter from those of the butenyl compounds.

Dr. GLADSTONE said that the Society had rarely listened to a research so productive of new and interesting substances, and pointed out the interesting results which would probably be obtained by an examination of the refraction and dispersion of these new bodies.

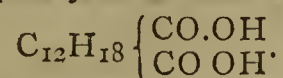
The thanks of the Society were then given to the author for the above paper.

Dr. ARMSTRONG then read a paper by M. M. P. MUIR, "On two New Methods for Estimating Bismuth Volumetrically." Chancel has shown (*Fahresber.*, 1860, 612) that bismuth is precipitated in the form of phosphate by the addition of a soluble phosphate to a solution of the metal in nitric acid. Both processes are based on this fact. In the first, bismuth is thrown down from nitric acid solution, after partial neutralisation with ammonia, by addition of a standard solution of sodium phosphate; the final point of the reaction is determined by spotting the supernatant liquid on a slab with warm ammonium molybdate solution. The results are approximately accurate. In the second process the nitric acid solution of bismuth is mixed with an excess of sodium acetate, a measured volume—excess—of standardised sodium phosphate is added, the liquid boiled, and filtered, the precipitate is well washed with hot water, and the excess of phosphoric acid determined in the filtrate by titration with a standard solution of uranium acetate. The results are very accurate. This second method is much to be preferred to the first, and is much more satisfactory than the author's dichromate process (*Journ. Chem. Soc.*, i., 483, 1876).

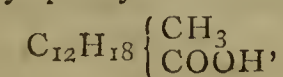
The next paper was also read by Dr. ARMSTRONG "On the Oxidation of Ditolyl," by T. CARNELLY, D.Sc. Last year in the production of tolyl-phenyl the author obtained a quantity of liquid and solid ditolyl as a by-product; by fractionating, solid ditolyl, melting at 121° C., and two liquid ditolyls, boiling about 275° and 285°, were obtained. These substances were oxidised with chromic and glacial acetic acids. Solid ditolyl gave on oxidation, first, dipara-tolyl-phenyl-carbonic acid,—



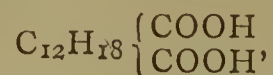
as a white powder, melting with blackening at 244°; and secondly, dipara-diphenyl-dicarbonic acid,—



The two liquid ditolyls gave identical results on oxidation, first, ortho-para-tolyl-phenyl-carbonic acid,—

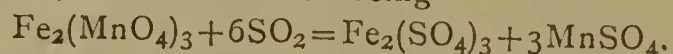


a white powder, melting at  $176^{\circ}\text{C}.$ ; secondly, ortho-para-diphenyl-carbonic acid,—



a white powder, which sublimes before fusing, and finally terephthalic acid. The above experiments show that when sodium acts on a mixture of para- and ortho-brom-toluene two isomeric ditolyls are produced, the dipara and ortho-para compounds. The author gives graphic formulæ showing the constitution and relations of the above bodies, and concludes by stating that he hopes to be able to prepare the diortho-ditolyl from it, obtain by oxidation diphenic acid, and thus confirm the constitution of phenanthrene.

The last paper was entitled "*Note on a New Manganese Reaction*," by J. B. HANNAY. When a solution of a manganous salt in strong nitric acid is warmed, with the addition of crystals of potassic chlorate, the whole of the manganese is precipitated as manganous manganate. If a salt of iron be present a double manganate of iron and manganese,  $2\text{Fe}_2(\text{MnO}_4)_3 \cdot \text{MnO} \cdot \text{MnO}_3 \cdot 12\text{H}_2\text{O}$ , is precipitated; no other metals seem to be precipitated with manganese under the same conditions. The precipitate is insoluble in nitric and sulphuric acids, and unattacked by caustic alkalies. Hydrochloric acid acts on it, and reducing agents rapidly decompose it. Sulphurous acid first attacks the iron, setting free manganese dioxide, which rapidly collects into little nodules having a considerable degree of coherence. The manganese slowly disappears, the final reaction being—



The principal interest in the above reaction is that it furnishes a good method of separating iron from aluminium, &c., without the use of pure caustic soda. The iron compound appears, under the microscope, as thin flexible plates, of a purple brown colour.

Mr. GROVES remarked that nothing was said by the author as to the effect of the presence of phosphoric acid on the reaction.

After the thanks of the Fellows had been given to the authors of the above papers the Society was adjourned to November 15, when the following papers will be read:—"On Gallium," by Prof. Odling; "First Report to the Chemical Society on some Points in Chemical Dynamics," by Dr. Wright and Mr. Luff; "On the Influence Exerted by Time or Mass in Certain reactions in which Insoluble Salts are Produced," by M. M. Pattison Muir; "On two New Fatty Acids of the Series  $\text{C}_n\text{H}_{2n}\text{O}_2$ ," by C. T. Kingzett.

#### PHYSICAL SOCIETY.

November 3, 1877.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

THE following candidate was elected a member of the Society:—Alexander Jessemann.

Prof. McLEOD described some experiments he has recently made to determine the exact number of vibrations of tuning-forks by means of the apparatus he exhibited to the Society on the 28th of April last, which was designed for determining slight variations in the speed of machinery or other analogous purposes. He has studied two sets of forks belonging to the Physical Laboratory at South Kensington, and a new set just received from Koenig, and his results exhibit a remarkable concordance, the extreme results in the worst set of observations on a fork of 256 complete vibrations only differing by 0.005 per cent; and in a good set they agreed within 0.00078 per cent. Examining the new series, from 256 to 512, he found them in all cases to give from 0.3 to 0.5 of a vibration more than was anticipated, but as this variation may be

due to a difference between the temperature and that at which they were adjusted, he is waiting to ascertain what this was. In reply to an enquiry of Dr. Guthrie, he stated his belief that a change in all probability does take place in the molecular condition of a fork with age. He considers also that the manner in which the fork is held has an effect upon its vibrations, and he hopes to be able to get some information as to the effect of temperature on elasticity.

Dr. HUGGINS exhibited some artificial gems recently prepared by M. Feil, the well-known glass manufacturer of Paris. He has succeeded in crystallising stones of the corundum class; and rubies, as well as a topaz and emerald, were exhibited. Dr. Huggins believes that the colour is imparted by small quantities of metallic oxides, and that the mass is mixed with boracic acid and maintained in a fused condition for a considerable period. M. Feil hopes to obtain larger stones by maintaining the heat constant for several weeks consecutively.

Dr. LODGE then read a communication from Profs. AYRTON and PERRY, of the Imperial College, Japan, in continuation of one read to the Society on the 26th of May last, on "*Ice as an Electrolyte*," and since published in the *Philosophical Magazine*. The experiments therein described led them to expect a very sudden rise in the specific inductive capacity as the temperature of the ice increased through zero, and it became water. Recent results have shown that, though rapid, this increase is not as great as they anticipated, and, whereas at  $-12^{\circ}\text{C}.$  the capacity is 0.002 microfarad, at  $+5^{\circ}\text{C}.$  it is 0.1185 microfarad, and after this temperature the increase was so rapid as to render exact readings difficult. Referring to Prof. Clerk Maxwell's theory, comparing electromagnetic disturbances with light vibrations, they point out that he exclusively regards a conducting medium. But they showed in a former paper that no dielectric can be considered non-conducting, hence they conclude that the measured specific inductive capacity can never be even approximately equal to the square of the index of refraction.

Prof. FOSTER mentioned that he recently had occasion to collect as many results as possible on specific inductive capacity and refractive index, and he found that where these figures were low the agreement with the law was fairly close, but with greater values the inductive capacity and the square of the refractive index separate very rapidly.

Prof. GUTHRIE described a simple means for showing the interference between plane waves by means of two long cords vibrating side by side. If a vibration of considerable amplitude be imparted to them and the plane in which they travel be carefully examined two faint black lines will be seen, which cross and re-cross each other more rapidly as the cords are less and less in unison, and with perfect unison remain stationary.

#### DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

October, 1877.

THE following communications have been received during the vacation of the Society:—

A. NAUMANN, "*Distillation of Aromatic Hydrocarbons by means of Steam*." The author describes a variety of experiments conducted with the view of determining the boiling-points of mixtures of water and hydrocarbons and the relative amounts distilled over. The results show that constant boiling temperatures prevail when steam is introduced into benzene, toluene, or xylene—viz.,  $68.5^{\circ}$ ,  $82.4^{\circ}$ , and  $89^{\circ}$ —independent of quantity or rapidity. These boiling-points are in all cases less than those of the hydrocarbons, and in all cases the temperature of the vapour was  $0.6^{\circ}$  to  $2.5^{\circ}$  higher than that of the liquid from which it proceeded. The ratios between the amounts of water and of hydrocarbons in the distillates was in each case

constant. 100 vols. of water were accompanied by 8.5 of benzene, 21.2 of toluene, or 44 of xylene.

G. LUNGE, "*Denitration of Nitrosyl-sulphate by Sulphurous Acid.*" Experiments are described which were designed to test the truth of Kuhlmann's and Vorster's statements, that in the Glover's tower an extensive reduction of NO to N<sub>2</sub>O, and even N, took place, and consisted essentially in conducting measured volumes of air and SO<sub>2</sub> over chamber-crystals heated to 110° to 200°, and then over sulphuric acid, the outflowing gases being carefully measured. The results showed that by this process, identical with that occurring in the pyrites furnace, the nitrosyl-sulphate is so decomposed that the entire amount of NO<sub>2</sub> is won back by absorption in the sulphuric acid, even when the heat mounted to 200°. No loss by the formation of N or N<sub>2</sub>O was noticed also under 130°, when SO<sub>2</sub> alone passed over the crystals and the oxidation of the NO took place later, although quite noticeable at 200°.

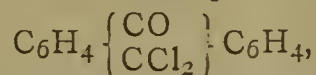
A. v. GROTE and B. TOLLENS have repeated their investigations on "*Levulic Acid*, C<sub>5</sub>H<sub>8</sub>O<sub>3</sub>," and find it and its compounds identical in most points with the β-acetopropionic acid.

G. VORTMANN describes at greater length the "*Cobalto-ammonium Compounds*" obtained by him from a solution of cobaltous carbonate in ammonia and carbonate of ammonium on treatment with HCl. They consist of octamin-purpureo-chloride, Co<sub>2</sub>.(NH<sub>3</sub>)<sub>8</sub>.(H<sub>2</sub>O)<sub>2</sub>.Cl<sub>6</sub>, crystallising into octahedrons, and easily changed into Rose's isomeric praseo-chloride; octamin-roseo-chloride, containing two additional molecules of H<sub>2</sub>O; octamin-sulphate, carbonate, and carbonate-sulphate; violet or red crystals yielding brilliantly coloured solutions, and some already well-known bodies.

S. NATANSON and G. VORTMANN have prepared "*Phosphides of Tin*" by heating vitreous phosphoric acid, charcoal, and tin together, by melting tin and vitreous phosphoric acid, by conducting P vapours over molten tin in a hydrogen atmosphere, and by throwing P on molten tin. These processes all yield a whitish crystalline product, containing from 0.7 to 2.8 per cent P. Treatment with HKO left a residue of the normal phosphide SnP.

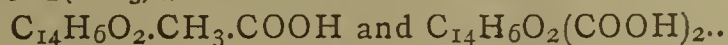
W. THÖRNER and T. ZINCKE, "*Studies on Pinacones and Pinacolines.*" From examination of benzpinacone and tolyl-phenyl-pinacone the authors observe that the pinacones by fusion are changed into the original ketones and corresponding hydrols, and that in the formation of the pinacolines from ketones pinacones appear as intermediate products.

"*Transformation of Ortho-benzyl-toluen Compounds into Anthracen Derivatives.*" By the action of Cl at 120° on tolyl-phenyl-keton an anthraquinon dichloride,—



was obtained, which is soluble in alcohol and acetic acid in the cold, but changes into anthraquinon on heating the solutions. Chlorinated anthraquinons are formed also by the action of PCl<sub>5</sub> on ortho-benzyl-benzoic and ortho-benzoyl-benzoic acids.

C. WACHENDORFF and T. ZINCKE, "*Methyl Derivatives of Anthracen.*" Dimethyl-anthracen, C<sub>14</sub>H<sub>8</sub>(CH<sub>3</sub>)<sub>2</sub>, has been found in high-boiling aniline residues. It melts at 225°, crystallises in yellow laminæ, and is oxidised by chromic acid and acetic acid to dimethyl-anthraquinon, C<sub>14</sub>H<sub>6</sub>O<sub>2</sub>(CH<sub>3</sub>)<sub>2</sub>, as well as the two acids—



P. HUNÆUS and T. ZINCKE, "*Styrolene Alcohol.*" The oxidation-products have been studied, and found to be in the first case benzoyl-carbinol, C<sub>6</sub>H<sub>5</sub>.CO.CH<sub>2</sub>OH, and in the second case benzoyl-formic acid, C<sub>6</sub>H<sub>5</sub>.CO.COOH. The former crystallises in large hexagonal laminæ, and possesses remarkable reducing properties. Acetic and benzoic ethers have been prepared, the latter of which is identical with the benzoate obtained on treating methyl-phenyl-keton chloride with toluen and benzoate of silver.

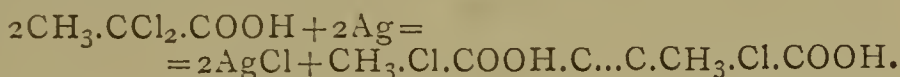
G. KRINOS prepares "*Trimellitic Acid*," C<sub>6</sub>H<sub>3</sub>(COOH)<sub>3</sub>, synthetically from xylic acid, C<sub>6</sub>H<sub>3</sub>.CH<sub>3</sub>(COOH)<sub>2</sub> by slowly oxidising with KMnO<sub>4</sub>, and shows the position of the carboxyl groups thereby to be 1.2.4. As trimesic acid possesses the position 1.3.5, the third isomeric acid, hemimellitic acid, receives the position 1.2.4.

H. BRUNNER and R. BRADENBURG obtain by the "*Action of Sodium on Mono-chlor-ethylen-chloride*," dichlor-ethylen, a reaction which explains the negative results of attempts to introduce the vinyl group into the benzene ring by means of this compound.

A. WERIGO and H. MELIKOFF prepare "*Dichloropropionic Acid from the Chloranhydride of Glyceric Acid*" by changing it first with alcoholic HKO into chlor-acrylic acid, and enclosing this with HCl at 100°. The acid thus obtained is identical with that derived from chlorhydrine or allyl-alcohol-dichloride.

R. SCHIFF, in experiments "*On the Constitution of Pyrrol*," has prepared an acetyl-pyrrol, C<sub>4</sub>H<sub>4</sub>N.C<sub>2</sub>H<sub>3</sub>O, by heating with acetic anhydride. This possesses remarkable crystalline properties, easily assumes 2 atoms of Br, and is un-attacked by K, Na, or C<sub>2</sub>H<sub>5</sub>I. These facts would seem to show the presence of an imide group in pyrrol.

H. BECKURTS and R. OTTO have examined the "*Action of Molecular Silver on α-dichloro-propionic Acid*." When 1 atom of Ag acts on a molecule of the acid the reaction yields an acid similar to dichlor-adipic acid—



If 2 atoms are used an acid analogous to hydromucic acid, C<sub>6</sub>H<sub>8</sub>O<sub>4</sub>.

J. PICCARD, "*Cantharidin.*" Vapour-densities of this body show that its formula must be double to C<sub>10</sub>H<sub>12</sub>O<sub>4</sub>. By the action of HI it is changed into cantharic acid, which possesses the same empirical composition, but is marked by strong acid properties, and has but half the basicity of cantharidin.

J. D. VANDER PLAATS, "*Hyponitrous Acid.*" The author prepares hyponitrite of silver, AgNO, by reducing a solution of KNO<sub>2</sub> with sodium amalgam, neutralising with acetic acid, and precipitation with AgNO<sub>3</sub>. The AgNO in the precipitate is purified by solution in dilute H<sub>2</sub>SO<sub>4</sub>, and precipitation by NH<sub>3</sub> in the form of a bright yellow powder. By addition of HCl to water containing the salt in suspension a solution of the free acid is obtained, which decomposes gradually, and disappears entirely in a fortnight.

O. N. WITT states that the "*New Dye-stuff*" lately synthetically prepared by Prof. A. W. Hofmann (CHEM. NEWS, vol. xxxvi., p. 51) is one of a series of sulfo-acids of azo-compounds of great tinctorial powers on which he is at present engaged.

F. FISCHER gives a tabulated statement of the "*Composition of the Gases Emitted from Potash Furnaces*," in which the oily matter of wool is consumed.

B. W. GERLAND describes at length his process for the "*Analysis of Vanadium Sulphates and their Double Salts with Alkalies.*" The solution of the salt in HNO<sub>3</sub> is treated with lead nitrate and alcohol for the precipitation of the sulphuric acid, and the precipitate freed from traces of vanadic acid by digestion with carbonate of ammonium or HNO<sub>3</sub>. The filtrate is treated with NH<sub>3</sub> and acetic acid, and the vanadic acid precipitated with lead acetate. The precipitate is dissolved in HNO<sub>3</sub>, the lead removed with H<sub>2</sub>SO<sub>4</sub>, the solution of vanadium sulphate evaporated to dryness, and then heated to a red-heat, at which temperature pure vanadic pentoxide remains. A small quantity of vanadium in the filtrate is obtained by removing the lead and repeating the process. The alkalies are determined in the final filtrate after precipitating the lead with H<sub>2</sub>S. Water determinations are made with sodic carbonate and potassic chlorate in a combustion-tube. The author regards titration of vanadium by means of KMnO<sub>4</sub> as exceedingly accurate, and uses inversely vanadic solutions for determining the titre of KMnO<sub>4</sub> solutions.

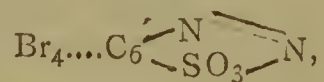
C. BÖTTINGER obtains by the "*Decomposition of Anilpyrroacemic Acid in Water*," an acid analogous to uvitonic acid, which receives the formula  $C_{20}H_{20}N_2O_4$ . Several salts are described.

G. REINHARD prepares by the "*Action of Sulphuryl Chloride on Resorcin*" dichloro-resorcin,  $C_6H_4Cl_2O_2$ , easily soluble, melting at  $100^\circ$ , and undecomposed by distillation.

O. WALLACH, "*On Chloral Derivatives*." Dichloroacetic ether is easily prepared pure by the action of chloral hydrate on an aqueous solution of potassic ferrocyanide, and treatment of the resultant potassic dichloroacetate with alcohol and  $H_2SO_4$ , and even more simply by the action of KOH on an alcoholic solution of chloral-cyan-hydrate. Small quantities are formed, also, when ehloral-cyan-hydrate and alcohol are enclosed in tubes at  $180^\circ$ . The reaction with potassic ferrocyanide explains, also, the formation of mono-chloro-crotonic ether from butyl-chloral and potassic cyanide.

W. KÖNIGS, "*Action of Sulphurous Acid and Sulphinic Acids on Diazo Compounds*." By the action of sulphurous acid on diazobenzene sulphate the author has obtained the hydrazine compound,  $C_6H_5NH.NH.SO_2C_6H_5$ . The same end is reached by reducing the reaction-product of diazo-benzene-sulphate and sodium-benzene-sulphinic acid,  $C_6H_5N_2.SO_2.C_6H_5$ , which is easily prepared, and resembles in its properties alkaline diazo-benzene-sulphonates, as  $C_6H_5N_2.SO_2.OK$ . The reaction with the two acids appears to be common to all bodies analogous to diazo-benzene.

H. LIMPRICHT, "*Constitution of the Diazo-Derivatives of the Benzene-sulphonic Acids*." The author judges from the three circumstances that the diazo-derivatives of benzene-sulphonic acids are unable to unite with acids, that the diazo-compound of tetrabromo-benzene-sulphonic acid can only receive the formula—



and that the diazo derivatives of neutral salts of amido-disulphonic acids are the same as those from the acid salts; that hence in the diazo derivatives of benzene-sulphonic acids 1 atom N replaces the atoms of H in the groups  $NH_2$  and  $SO_3H$ .

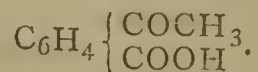
"*Decomposition of Substituted Benzene-sulphonic Acids by  $H_2O$  and Acids at High Temperatures*." The various bromine derivatives lose the  $SO_3$  group on treatment with acids at high temperatures. When  $NO_2$  in addition is present the reactions are usually more complicated. In the amido derivatives the decompositions are exceedingly irregular, dibrom-aniline-sulphonic acid yielding, for example,  $H_2SO_4$ , two dibrom-anilines, and a tribrom-aniline.

C. REISCHAUER, "*Fuglon*." An extended series of analytical results with regard to this body, which is formed in the green shells of walnuts, are taken from the notes of this deceased chemist.

S. GABRIEL and A. MICHAEL, "*Action of Dehydrating Agents on Acid Anhydrides*." The authors describe more fully the preparation of phthalyl-acetic acid from phthalic anhydride, acetic anhydride, and sodium acetate, and give it the formula  $C_6H_4.(CO)_2.CH.COOH$ . Alkalies change it into a benzoyl-acetic-carbonic acid,—



By fusion it yields an aceto-phenon-carbonic acid,—

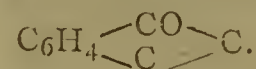


Bromine and ehlorine change phthalyl-acetic acid into tribromo- and trichloro-aceto-phenon-carbonic acids,—



With  $NH_3$  phthalyl-acetamide,  $C_6H_4(CO)_2CH.CONH_2$ , is

formed. Concentrated  $H_2SO_4$  gives rise to a compound crystallising in fine yellow needles, melting at over  $300^\circ$ ,—



Sodium amalgam forms two acids of the formula  $C_{10}H_8O_4$ , one of which is dibasic, the other monobasic. By the action of sodium acetate on phthalic anhydride and succinic acid the authors obtain a compound crystallising in yellow needles an inch long, soluble in aromatic liquids, to which they give the name ethin-diphthalyl,—



Alkalies change it into a dibasic acid, phenyl-ethylenketon-carbonic acid, and Br forms  $C_{18}H_{10}Br_2O_4$ .

P. G. W. TYPKE, "*Some Diazo-benzene Derivatives*." The dioxy-azo-benzene of Baeyer and Jäger, prepared by mixing diazo-benzene nitrate and resorcin, is found to be a mixture of two isomeric bodies. A tribromo-derivative of the alpha compound was obtained by adding Br to the acetic acid solution. Methyl-dioxy-azo-benzene was obtained in a similar way from orcin. Its solutions, like those of dioxy-azo-benzene, are of a deep orange, and possess a notable tinctorial power. A dibromo-derivative was obtained. Diazo-benzene and alpha-naphthol yield an amorphous brown powder,  $C_6H_5.N.N.C_{10}H_6(OH)$ , azo-benzene-alpha-naphthol, which likewise possesses strong colouring properties. It yields no Br compound, but forms with  $H_2SO_4$  a sulphonic acid, the solutions of which impart a brilliant orange-red to textile fabrics. It is probably identical with the acid alluded to by O. Witt above.

A. L. THOMSEN, "*Mono- and Dimethyl-toluydins*." The former is prepared from para-toluydin by the action of  $CH_3Cl$ , and subsequent distillation with acetic anhydride, as done by Prof. Hofmann in the case of mono-methylaniline (CHEMICAL NEWS, vol. xxxv., p. 141), and forms a yellow oil boiling at  $208^\circ$ . Nitroso- and dinitro-derivatives were prepared. Ortho- and para-dimethyl-toluydins were obtained from the corresponding trimethyl-toluyll-ammonium iodides by the action of  $Ag_2O$  and subsequent distillation; and form colourless oils, boiling respectively at  $208^\circ$  and  $183^\circ$ .

O. LANDGREBE, "*Cyan-guanidins*." The author obtains from ditolyl-guanidin a dicyano compound,  $C_{15}H_{17}N_3.Cy_2$ , analogous to dicyano-diphenyl-guanidin, which is changed by HCl into ditolyl-oxalyl-guanidin,  $C_{17}H_{15}N_3O_3$ , and in an alcoholic solution into ditolyl-parabanic acid. From aniline and dicyano-diphenyl-guanidin he obtains a dicyano-triphenyl-guanidin, identical with that prepared by Hofmann from the action of cyanogen on aniline as a by-product.

## CORRESPONDENCE.

### BORIC ACID.

To the Editor of the Chemical News.

SIR,—In a lately published work on chemistry, by Profs. Roscoe and Schorlemmer, under the head of "Boron Trioxide," the following passage occurs:—"Most metallic oxides dissolve in fused boron trioxide at a red heat, many of them imparting to the mass characteristic colours; hence this substance is much used in blowpipe analysis."

Now this statement seems merely the repetition of a mistake, transferred from one book on chemistry to another, to which I have been attempting in vain to call scientific attention for the last eight years. It is particularly referred to at page 275 of my published work, "Pyrology," under the head of "Cobalt," the oxide of which supplies an excellent illustration in point.

Most metallic oxides do *not* dissolve in boric acid before the blowpipe; do *not* impart colours to it; and, finally, it

is *not* much used in blowpipe analysis, except for that made upon my system, which (as regards boric acid) is grounded upon the non-solubility of almost all metallic oxides, added to a bead of that reagent before the blowpipe. In short, what the chemists have written of the behaviour before the blowpipe of metallic oxides in "boron trioxide" is true, not of it, but of *borax*, a very different substance.

I would appeal to any operator who has used boric acid in this manner for a confirmation (or contradiction) of these remarks.—I am, &c.,

W. A. Ross.

## ON THE MOTIONS OF CAMPHOR ON THE SURFACE OF WATER.

To the Editor of the Chemical News.

SIR,—I beg to thank Mr. P. Casamajor for his courtesy in sending me a copy of his paper on this subject, contained in the CHEMICAL NEWS (vol. xxxvi., p. 191). It has already been discussed several times in your pages, and I may especially refer to your volume for the latter half of 1863 for a number of details.

Mr. Casamajor's ingenious paper contains arguments in favour of a theory that has been more than once taken up and abandoned, while it neglects the real theory which has at various times given indications of its presence, until a few years ago it was completely established. This is by no means an unnatural result, considering that the phenomena in question have been discussed during upwards of a century and a half by some of the ablest physicists, until they have become so beset with theory that, like a rose in a deserted garden, the true theory has been smothered in the weeds of the false. As early as 1785 Lichtenberg noticed that on plunging a thermometer into the water on which the camphor fragments were rotating the motions suddenly ceased in consequence, as he sagaciously supposed, of some alteration in the surface, or the thermometer not being quite clean the surface became covered with a film.

Volta in 1787 referred the motions to an effluvium which escaped from the camphor explosively, after the manner of a firework, and produced motion by reaction. Prevost adopted this or a similar theory, and in his interesting controversy with the Italian physicist, Carradori, supported his view by much ingenious argument and experiment. In 1794, or even earlier than that, Carradori started his theory of surface attraction, *sull' attrazione di superficie*, on which, as he maintained, and on no other cause, the motions of camphor depend. Prevost replied with what he deemed a crucial experiment. If, he argued, these motions depend on the attraction of the surface, contact between the camphor and the surface of the water must be necessary; "but I can produce these motions," he said, "without any such contact." A bit of camphor on a raft placed on the surface of water will move about briskly, which proves, not that contact is necessary, but that the action of vapour at a distance is.

It is interesting now to sympathise with these two eminent men, who were both right in their respective views, seeing that the subject was not then ripe enough for reconciliation. Carradori replied by denying the possibility of such a result as that pointed out by Prevost, and I confess that in writing my History of this subject I was so impressed with Carradori's reasoning that I endeavoured to repeat Prevost's experiment with a strong prejudice against it—the very best preparation for failure that could possibly be adopted—and accordingly I failed. I tried a raft of tin-foil, and also one of cork; but some years later, when it became necessary that the experiment should succeed, I was led to suppose that the tin-foil was too heavy and the cork too thick for the production of a favourable result. In the *Philosophical Magazine* for December, 1869, I thus describe the result:—"I formed a raft of a small square of mica, placed on it a bit of cam-

phor about the size of a small pea, took up the raft on the point of a penknife, and so launched it upon the surface of 6 ounces of water contained in a very clean cohesion-figure glass  $3\frac{1}{2}$  inches in diameter. Before the raft had touched the water a visible shudder passed over its surface, showing the action of camphor at a distance. No sooner was the raft fairly launched than it began to sail about, and continued to do so with gradually slackening effort during a whole week. The advantage of using mica is that its surface is almost *à fleur d'eau*, and it sails about without allowing the camphor to be disturbed or to become wet."

In 1842-3 Dutrochet published a work in two parts, in which not only the motions of camphor, but a vast number of other interesting facts are traced to the influence of a force residing on the surface of liquids, and hence named *epipolii* (επιπολη, surface). This is, in fact, the attraction of superficies of Carradori, which seems to have been unknown to Dutrochet. The latter observer is by no means consistent with himself in the various sections of his work, nor does he seem to have formed any very clear idea as to the nature of the force he was dealing with.

But the nature of the force that was to explain these camphor-motions had been, and was being, studied by a set of distinguished men without any special reference to the phenomena in question. The researches of Segner in 1751, and of Dr. Thomas Young, in 1806, rendered it very probable that there exists a contractile force or tension at the surface of liquids. The labours of Henry, Lamarle, Dupré de Rennes, Plateau, and others converted this probability into a certainty, so that the existence of such a force is not only capable of proof, but can also be expressed numerically for different liquids at a given temperature.

In 1862 Prof. Van der Mensbrugghe presented to the Royal Academy of Sciences of Belgium a memoir in which the motions of camphor and other bodies, liquid and solid, on the surface of water are accounted for on the principle of the surface-tension of liquids. It would occupy too much space in these columns were I to enter into details respecting this beautiful memoir, but I may refer to three papers of mine in the *Phil. Mag.* for December, 1869, January, 1870, and November, 1873, for a discussion of the various matters arising out of these phenomena and the new theory. There, too, Mr. Casamajor will find the electrical theory discussed, and some of the facts brought forward by him, accounted for in the surface-tension theory. For example, if a clean surface of water be very lightly dusted over with lycopodium contained in a muslin bag, and a bit of camphor or a greasy finger be dipped into the water the particles of dust will suddenly be repelled in a manner that is provokingly like electrical action.\* But the fact is that we lower the surface-tension at the point touched, while the superior tension of the subjacent parts drags upon the weakened portion, and so produces the apparent repulsion. A bit of sponge tied to the end of a glass rod, and wetted with ether, held over the dusted surface is still more striking. Now, taking the surface-tension of water as = 7.3, and that of ether as = 1.88, it will be seen that there is a large residue of force in favour of the tension of water sufficient to account for the motions in question.

Mr. Casamajor will perhaps be so good as to reconsider his statement respecting evaporation as connected with the camphor motions. Let him try to repeat the experiment in a large clean stoppered bottle half full of clean water, but with the stopper in, and the experiment will fail. The fact is, that although the motions will continue

\* A friend of mine, some years ago, informed me that having to visit a Swedish iron-forge for the purpose of making some chemical analyses, one of the engineers of the establishment puzzled everybody by producing the sudden repulsion of dust upon the surface of a water-tank by simply dipping his finger into it. No one else could produce the same effect, until my friend noticed that before producing it the experimenter always put his finger to his ear. My informant did the same: got out a little wax, smeared it over his finger, and then produced the same result. I may add, after having tried the experiment, that wax from the ear rotates on water after the manner of camphor

for days together in an open vessel exposed to the dust of the room, evaporation not only prevents the water from becoming saturated with camphor, but also maintains the tension of the surface sufficient for the production of these motions, which are due to the difference between the tension of water and that of the camphor solution at different points of the surface.—I am, &c.,

C. TOMLINSON.

Highgate, N., Nov. 6, 1877.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Bulletin de la Société d'Encouragement pour l'Industrie Nationale.*

No. 46, October, 1877.

Report presented by M. Lamy on behalf of the Committee of Chemical Arts on M. C. Vincent's paper, entitled "Products of the Distillation of the Vinasses of Beet-root.—One of the most abundant raw materials for the production of alcohol is the treacle resulting from the manufacture of beet-root sugar. When fermented and distilled it yields alcohol, and leaves as a residue a very aqueous brown liquid, known as "vinasse," containing the greater part of the non-volatile matter, organic as well as mineral, found in the saccharine juice of the beet. As early as 1837 Dubrunfaut showed that it was possible and advantageous to extract from it the salts of potash and soda present, and in this manner 2000 tons of alkaline salts are produced in France alone. The usual procedure is to concentrate the *vinasses*, evaporate to dryness, and calcine on the sole of a specially-constructed reverberatory furnace. M. Vincent's improvements consist in performing this operation in closed vessels, so as to utilise the volatile products. In this manner he collects ammoniacal liquor and tar. The former contains not merely salts of ammonia, but methylic alcohol, methylic sulphide and cyanide, salts of trimethylamin and of the principal fatty acids. The tar yields, among other products, phenol.

Report Presented by M. Cloëz on behalf of the Committee of the Chemical Arts on the Products of Vulcanised Caoutchouc from the Works of M. Eug. Turpin.—These products are artificial parchment, vegetable ivory, dentist's caoutchouc, and toys of the same material. The parchment serves as a substitute for the glazed papers, fine skins, gold-beater's skin, &c., used by perfumers, druggists, &c., to cover bottles, jars, &c. The vulcanisation is effected by the action of sulphur chloride dissolved in carbon bisulphide.

Nitro-glycerin, Dynamite, &c. (continuation).—M. Brull.—The author treats on the force of nitro-glycerin and the amount of heat liberated, and draws a comparison between gunpowder and nitro-glycerin. Nitro-glycerin heated suddenly to 180° explodes; if heated gradually to 193° it is decomposed, according to Champion, without ignition or detonation, but this assertion is contested. Neither the sparks of the Leyden jar, nor those of the induction-coil, nor currents of dynamic electricity cause it to explode.

*Reimann's Färber Zeitung,*  
No. 35, 1877.

This issue contains nothing of general interest.

No. 36, 1877.

This issue is to a great extent taken up with the affairs of the new Dyers' College at Berlin.

No. 37, 1877.

Artificial alizarin has fallen considerably in price, owing, it is said, to the prohibitive duty imposed on its importation into Russia.

## MISCELLANEOUS.

The Institution of Civil Engineers.—In the Circulars announcing the commencement of another Session—the sixtieth year since its establishment—attention has again been directed to the importance of there being an unfailing supply, for reading at the weekly meetings, of Original Communications calculated to raise useful discussions. As an aid in this direction a list of subjects for papers has just been issued, prefaced by a statement of the funds at the disposal of the Council for rewarding the authors of meritorious communications. It has also been pointed out that it is equally essential that the "Minutes of Proceedings" should be made the depository of other original communications which from various circumstances are deemed better suited for publication alone than for reading and discussion at the meetings. The volumes likewise contain "Abstracts of Papers in Foreign Transactions and Periodicals," the aim in the latter case being to present a succinct *résumé* of the current engineering literature of all countries. The opening Meeting of the Session 1877-78 has been fixed for Tuesday, the 13th instant, when a "Review of the Progress of Steam Shipping during the last Quarter of a Century," by Mr. Alfred Holt, M. Inst. C.E., of Liverpool, will be read and discussed.

## NOTES AND QUERIES.

Portland Cement (reply to A. P.).—Reliable in theory and practice: W. Michaelis, "Die Hydraulischen Mörtel, Insbesondere der Portland Cement." Leipzig, 1869 (Oquandt and Händel).—MANUFACTURER.

Portland Cement (reply to A. P.).—A. P. will find a good deal of valuable information on cements in "Reports and Awards," Group ii., Philadelphia Exhibition, from p. 147. May be had of Messrs. Lippincott and Co., Covent Garden.—JOHN CLIFF, Runcorn.

Crystals in Glass Manufacture, &c.—I am employed in a glass bottle works in this town, and under the microscope I find in any bad or devitrified glass we may make, a number of crystals of various shapes. Can any of your readers refer me to any book and diagrams which would teach me to recognise the different crystals? Also to any good books on glass which would be useful to a young man who has lately commenced the study of chemistry.—TYRO.

## MEETINGS FOR THE WEEK.

TUESDAY, Nov. 13th.—Civil Engineers, 8.

WEDNESDAY, 14th.—Society of Public Analysts, 8. At Burlington House, Piccadilly, to consider and discuss a Report from the Council as to the working of the Sale of Food and Drugs Act, in order to enable a formal reply to be made to some inquiries by the representative of the German Government, who propose to introduce an Adulteration Act themselves. "On Milk Analysis," by J. Carter Bell, F.C.S. "On the Analyses of Five Mineral Waters," by Otto Hehner, F.C.S.

THURSDAY, 15th.—Chemical, 8. "On Gallium," by Prof. Odling. "First Report to the Chemical Society on some Points in Chemical Dynamics," by Dr. Wright and Mr. Luff. "On the Influence Exerted by Time and Mass in Certain Reactions in which Insoluble Salts are Produced," by M. M. P. Muir. "On Two New Fatty Acids of the Series  $C_nH_{2n}O_2$ ," by C. T. Kingzett.

## TO CORRESPONDENTS.

J. B. W.—We are not aware of any recent researches on the subject. Should we meet with anything we shall insert it in our columns. *Chemical Student*.—Consult Church's or Johnson's works on the subject.

W. H. K.—Carbolic acid dissolves in water, the other oils do not. We gave the test you require in our report in 1866 to Her Majesty's Commissioners "On the Application of Disinfectants in Arresting the Spread of the Cattle Plague." This report is now out of print, but you will find it in the CHEMICAL NEWS, No. 340, vol. xiii., p. 270.

# THE CHEMICAL NEWS.

VOL. XXXVI. No. 938.

## ALUMINIUM PLATE AS A SUPPORT IN BLOWPIPE WORK.

By W. M. HUTCHINGS.

(Concluded from p. 210.)

I now give the list of sublimates, which anybody wishing to study should produce for himself. Where the pure metals themselves are used to produce them small pieces only should be taken, so that the size and appearance of the sublimate may be pretty much the same as what would be obtained from a mineral containing a fair amount of the metal in question. The least amount of heat and blast should be employed which will suffice in each case to produce a good distinct sublimate, which is always best when produced slowly. Too much heat or too strong blowing causes the fumes to be unnecessarily spread out. The mouth-blowpipe is best suited for this work, with a good taper nozzle and moderate bore, capable of giving a long, pure, blue flame,—not one of the blunt-ended monsters so generally seen in use in laboratories,—price about 6d.!

### Arsenic.

(Fragments of *Niccolite* or *Smaltite* are better for observing this sublimate than native arsenic.)

When the quantity given off is not large the sublimate is white, and there is a black stain under the assay when it is heated directly on the plate. When much arsenic is present, and is given off rapidly (as when the assay is supported on a charcoal-slip), there is also a good deal of grey-black sublimate, and there are large black stains on the ledge.

*In P.F.*—The white portion is unaltered, but volatilises rapidly as the plate gets hot. The grey-black and black portions are somewhat whitened and partly removed, but dark stains remain.

*In R.F.* (blue tip).—The white is not darkened, but volatilises rapidly. The arsenic-smell is better noticed when substances are heated on the bare plate, or on the small charcoal-slip, than on the ordinary large pieces of charcoal.

### Antimony.

The sublimate is pale yellow just in front of the assay, where it is thickest; further off it is pure white, shading off into bluish white film. It is much more compact and closer to the assay than when obtained on charcoal in the usual way. Most minerals containing antimony give off almost the whole of it while heated on the bare plate, before using charcoal-slip.

*In P.F.*—The white outer portion is unaltered. The yellow portion is more strongly yellow while heated, but pales again on cooling.

*In R.F.*—The white and yellow portions are instantly turned black by being touched with this; indeed the blackening takes place before the tip of the flame touches the plate at all. This is the best characteristic of the antimony sublimate, and is so sensitive that the faintest film gives a deep black circle wherever it is touched by the flame, enabling it to be recognised when only a very minute sublimate is obtained, or on the outer edges of mixed sublimates. There are several other metals whose sublimates darken in R.F., but there is nothing else which turns to black, and the only others which are affected so instantaneously are those of molybdenum and selenium, which can never be mistaken for antimony.

*Stibnite* and the various minerals containing antimony sulphide, unless heated very gently at first, give off a sub-

limate of unoxidised sulphide, dark yellow and yellowish red, which oxidises on further exposure to the flame.

### Lead.

When a small piece of pure lead is heated directly upon the plate, it is only after long blowing, when the whole of the plate gets heated, that a small sublimate is obtained. Heated on a charcoal-slip a copious sublimate is at once formed. In front of the assay is first a narrow strip of pale yellow, which passes into orange, and this into a band of deep coffee-brown shading off into yellowish brown. Outside of all, and on the ledge, is a thin white sublimate. The yellow and orange are small in amount compared with the coffee-brown, which is the largest portion of the sublimate. (See *Bismuth*.)

*In P.F.*—The pale yellow and the orange are rapidly turned deep brown, like the darkest portion of the original sublimate. The outer white is also strongly browned, even where only a thin film of it is present, though not so deeply as the rest. All the portions of the sublimate retain the brown colour completely on cooling. (See *Bismuth*.)

*In R.F.*—All the portions of the sublimate turn almost black, but the reduced parts have a very different appearance from, and take much longer to form than, those of antimony.

### Lead with Antimony.

The detection of antimony in lead, even if present in very small amount, is much more easy and certain on aluminium than on charcoal in the ordinary way. By heating the lead directly on the ledge, the antimony is obtained practically free from lead, which, as above mentioned, can only with difficulty be made to give any sublimate on the bare plate. If very little antimony indeed is contained, the bit of lead is best placed on the plate together with a bit of fused boric acid about half its size, and the two heated very strongly. Nothing at all will be obtained for some time, but, as the heat of the plate increases, a small, pure, white antimony sublimate will form slowly. The boric acid serves the double purpose of holding the little ball of lead from rolling or being blown away, and of taking up what little oxide of lead is formed. It is in cases like this that the superiority of aluminium is most apparent; an amount of antimony that would be completely dissipated on ordinary charcoal is here condensed into a small compact sublimate; and when so little is present as to give only a barely distinguishable film, it is proved to be antimony by its instant blackening in R.F.

*Bournonite*, *Boulangerite*, &c., treated on the bare ledge, give off almost all the antimony without any lead; afterwards, on the charcoal-slip, a sublimate of lead with little antimony; and finally a pure lead sublimate can be obtained.

### Bismuth.

For the bare plate the same remarks apply as to lead. Obtained from the charcoal-slip the sublimate, like lead, is yellow nearest the assay, passing into orange, and this into brown. The yellow is darker than with lead, and the yellow and orange are much more extensive than the brown (reverse of what is obtained with lead); also this brown is not nearly so dark as that of lead, and has quite a different appearance. Outside of all, and on the ledge, is a good deal of pale yellow sublimate.

*In P.F.*—The yellow and orange darken in colour, but nothing like as much as the lead sublimate, and the greater part of the darkening disappears on cooling. This is a very characteristic difference between lead and bismuth.

*In R.F.*—Same as lead.

On charcoal, in the ordinary way, the lead and bismuth sublimates are so much alike that they can hardly be distinguished. It will be seen that on aluminium there are sufficient differences to render the distinction much more easy. If a little bismuth is suspected in a lead sublimate, a small quantity should be scraped off, and examined by

the test with "microcosmic salt" and tin. This test may always safely be used in the absence of antimony, because, although lead oxide will produce the same darkening of the bead, still so much of it is required to produce the same effect as that of a very minute quantity of bismuth oxide that there is no danger of mistake if only a small amount of the sublimate is dissolved. This is easily proved, and the limit as to quantity of sublimate which may safely be dissolved is ascertained by a few experiments with pure lead sublimate, and with one containing a little bismuth.

Von Kobell's beautiful test for bismuth, by use of potassium iodide and sulphur, acts splendidly on the aluminium plate, either on the bare ledge or charcoal-slip. The red sublimate forms nearer the assay than on ordinary charcoal. Much lead obscures the reaction, rendering the bead-test necessary.

#### Cadmium.

A dark brown, almost black, sublimate, which is not altered by P.F. or R.F.

A little reddish brown sublimate is mostly seen on the edges of the charcoal-slip.

#### Zinc.

It is scarcely possible to obtain any sublimate at all when a bit of pure zinc is heated on the bare ledge. Heated on the charcoal-slip, a bit of metal, at the moment when it takes fire, gives an almost black sublimate on the plate. This black sublimate is not obtained when zinc minerals are treated. After this the sublimate of zinc oxide forms, and is just the same as on ordinary charcoal—yellow hot, and white cold. In P.F. and R.F. unaltered. The greater portion encrusts the charcoal-slip just round the assay, and is tested with cobalt solution.

#### Tin.

On bare plate, same as zinc.

On charcoal-slip the greater portion of the sublimate is close to the assay, on the charcoal, and is tested with cobalt solution. A small white sublimate forms on the plate, very slowly.

*In P.F.*—Unaltered.

*In R.F.*—Is darkened very slowly, and not very much.

#### Molybdenum.

This sublimate is best produced either from a bit of the native sulphide, or from a bit of ammonium molybdate the size of a large pin-head, laid on the bare ledge, and heated a long way from the tip of a strong flame. It is pale yellow where thickest, and white farther off.

*In P.F.* it is yellower while hot; pales again on cooling.

*In R.F.*—An instant contact, such as passing the sublimate very rapidly through the flame, produces the same splendid blue colour as on the ordinary charcoal, only that it has even a more beautiful colour on the aluminium. If the sublimate is slowly brought up from some distance towards the flame, it will be seen to turn blue when still a good way from the blue tip, being rather more sensitive than antimony. As it is much more concentrated on aluminium, and the blue obtained from the slightest film is much better seen than on charcoal, a smaller amount could be detected.

The further reduction of the blue to copper-red cannot be obtained on aluminium as it can on charcoal.

#### Thallium.

A small piece of the metal, heated very gently on charcoal-slip, gives at first a copious white sublimate, which spreads far to the sides and up the plate. After a few moments, as the heat of the slip increases, a dark sublimate is also given off, which is not so much spread out. It is strong reddish brown where thickest, passing off through lighter shades into the outer white.

*In P.F.*—The white portion instantly turns reddish brown, and this takes place best fully 2 inches in front of the tip. This is very characteristic; the browning of the

lead sublimate is not nearly so rapid, and the colour produced is very different.

*In R.F.*—Both the original brown sublimate and that produced from the white give black metallic stains, and, where thickest, little black balls can be seen with a lens.

#### Selenium.

Substances containing selenium are characterised by the peculiar "horse-radish" smell given off on heating, especially on charcoal-slip; and by the red or copper-coloured sublimate obtained, both on the bare plate and on the charcoal-slip. There is also some brown and white sublimate produced.

*In P.F.*—The red and brown portions are whitened over.

*In R.F.*—All the parts turn a rich dark velvety brown. The action is almost as instantaneous as in the case of antimony, but the colour is very different, and with the other special characteristics of selenium there is no danger of their ever being mistaken.

*Clausthalite* (from Tilkerode) on the bare ledge gives a sublimate of selenium without any lead. On charcoal-slip, gently heated, more selenium sublimate comes off, almost free from lead, and finally the lead sublimate.

#### Silver.

A good-sized piece of pure silver, placed on a charcoal-slip, rapidly gives a large sublimate on the plate. It is brown in the centre, shading off into a lighter rim having a reddish tinge; and down below, where the glowing edge of the charcoal-slip has been close to it, is a narrow slip, almost white, with faint pink tinge.

*In P.F.*—This strip and the lighter-coloured rim darken, and the entire sublimate is turned a much darker brown.

*In R.F.*—A circle of white is produced by contact with the blue tip, looking very much like "frosted silver." It is produced very rapidly on any part of the sublimate. The dark brown is at once reproduced by exposing again to P.F. In addition to the silver carried over as sublimate, little balls and splashes of metal are seen, under the lens, which are thrown out by the occasional "spitting" of the fused ball of silver.

This sublimate from metallic silver, though interesting as showing the great ease with which silver is volatilised by heat and blast, is not of use as a test. The beautiful rose-coloured sublimate produced when silver is volatilised with lead or antimony, or both together, is, according to Plattner, a certain indication of the presence of silver in a mineral from which it is obtained. The colour from silver and antimony, on aluminium, is similar to that on charcoal, but it comes out better and is produced earlier on in the process.

Owing to the colour of most of the lead sublimate being so much darker on aluminium than on charcoal, the rose-colour is only obtained with lead and silver on the outer edges. Where these begin to pass over into the brown, the rose gets changed into a darker purple-red tint, and is soon lost in the deep coffee-brown, so that lead is not as well suited on aluminium for the observation of the rose sublimate as on charcoal, though it is always easily recognised. Ross believes that in this rose sublimate we have a delicate and valuable test for silver in ores, a little of the powder of which is to be heated on a charcoal-slip with a little assay-lead free from more than traces of silver. I have made many trials by heating various samples of ore, of very varying composition and richness, with addition of lead, and lead with antimony, but I do not find the test of much value. In some cases of rather poor ores a distinct rosy colour was obtained, while in others of great richness (for commercial samples) no sign of it was seen; these differences being apparently caused by the action of other constituents of the ore. Quartz and silicates, for instance, in any considerable amount, seemed to render it impossible to obtain this sublimate.

There is no doubt that the sublimate from a ball of pure silver is metallic only; but this is by no means so certain

in the case of the rosy sublimate. It is very probable that, in company with lead and antimony, some, at least, of the silver is volatilised as oxide.

### Gold.

I believe Major Ross was the first to give gold among the metals whose sublimates can be obtained with the common blowpipe, which is owing to the fact that it can be easily produced and seen on aluminium, though not on ordinary charcoal. No doubt it could be observed on the porcelain supports. Ross appears to have produced it only from a ball of gold and lead, as he makes no mention of getting it from pure gold. In his book is a coloured representation of a very beautiful sublimate obtained from gold with a little lead; and it appears that he regards the lead as necessary for the operation, attributing the colours to *oxide* of gold, formed and volatilised by the action on the gold of the lead oxide produced. But I find that a very fine gold sublimate can be obtained in two or three minutes by strongly heating a little ball of perfectly pure gold on a charcoal-slip on the ledge.\* The mouth-blowpipe suffices, but it is got more quickly, and better, by using a stand-blowpipe and hand-blower. After two minutes' blowing the appearance on the plate was as follows:—Nearest the charcoal, where the heat on the plate had been greatest, was a small arch of pale yellow colour—just a thin film of gilding over the aluminium. Beyond this was a strip,  $\frac{1}{4}$  to  $\frac{1}{2}$  inch wide, of a beautiful violet or purplish violet colour; and dotted all over the sublimate were little specks and splashes of gold carried over mechanically. By heating for a much longer time, with frequent stopping to let the plate cool, very fine sublimates may be produced. The sublimate with lead, described by Ross, seems to me to be simply that of metallic gold placed over that of lead oxide. It takes much longer to produce, and does not seem to be appreciably formed till all the lead is driven off. The purplish violet obtained is clearly the same as the deposit on white paper held under a fine gold wire through which a powerful electric discharge passes; and it is certainly interesting to be able to obtain the same appearance by means of the blowpipe.

In connection with this gold sublimate is a very pretty little experiment, first stated, I believe, by Ross, to which—as it is very interesting and not much known—I should like to allude, although it does not form any part of the subject of these notes. He found that if a bead of phosphoric acid is made on platinum wire (by taking up and gradually heating successive small fragments of pure glacial acid) it will easily, in O.F., dissolve gold-leaf. If then held a little while about an inch from the tip of the flame, it will on cooling take a beautiful bluish violet tint. If very little gold is dissolved, a faint tinge, or perhaps streaks only, of a fine pink will be obtained. I find that by varying the quantity of gold dissolved various shades of pink, ruby, violet, purple, green-blue, and finally a splendid blue, may be produced. On heating again the colour rapidly disappears, the bead being yellow hot, and taking the colours again on cooling. This disappearance and re-appearance may be repeated any number of times, only that the colour is seldom twice running the same. A bead will cool once a deep blue, and perhaps next time a pink or violet. It succeeds best in a good large bead, so that phosphoric acid should be added from time to time to replace what is volatilised. If the hot pale yellow bead is cooled suddenly no colour appears; but it can then be produced by very gently heating (so that the bead is just softened) a good way from the tip of a very small flame. Ross believes the colour to be caused by an oxide of gold, but it seems as if it were produced in the same manner as the colours of the rose-red and ruby glass made on the large scale by means of gold, and which are considered to depend upon a separation in the

glass of finely-divided metallic gold. The metal is doubtless dissolved to a phosphate which has a pale yellow colour in the bead; but on cooling slowly, or gently annealing, the glass cannot retain the gold in solution, and so it separates out more or less, giving a colour according to the quantity liberated.

I find that "microcosmic salt" dissolves gold-leaf as rapidly and as easily as does phosphoric acid, giving the same yellow colour hot, and taking even more beautiful colours in cooling, though it is more capricious than phosphoric acid, and frequently cools quite colourless, even when a large quantity of gold is dissolved. When this takes place with a large bead any shade of the colours may be produced by very gently heating the bead as above—from the faintest pink at the beginning to a deep blue at the end. At one stage a magnificent ruby is got, at another the same colour as the gold sublimate on aluminium, and at another bluish green. All the beads appear perfectly transparent.

I do not find this easy solubility of gold in phosphoric acid or in sodium phosphate mentioned anywhere but in Ross's book, and he appears only to have observed it with the acid.

I find gold-leaf is also dissolved in borax, though not so easily as above. When a good deal is dissolved the bead has the same yellow colour hot, and cools to a very faint green-blue tinge. None of the above colours can be got either during cooling or by annealing; indeed if a little borax is added to a bead of "microcosmic salt" which has a large quantity of gold in it, and which is capable of giving the deepest colours, this property is at once destroyed, the bead being then just like a borax bead, and no colour being obtainable. Gold-leaf is of course best for these experiments, because it dissolves most rapidly; but even from a little ball of gold, held in the centre of the loop and kept clear of the wire, sufficient gold is taken into solution in a few minutes to give the deep blue.

These little experiments are so pretty and interesting that I hope I need not apologise for taking space to allude to them for the benefit of those to whom they are unknown.

ERRATA.—Page 209, column 1, line 14 from top, for "just" read "first." Page 209, column 2, line 7 from bottom, for "paste" read "plate."

## REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.\*

By Dr. A. W. HOFMANN.

(Continued from p. 208.)

*Phosphorus and Matches.* By Dr. ANTON VON SCHRÖTTER  
Master of the Imperial Mint at Vienna.

THE reporter at an early date had proved by his researches on the remarkable behaviour of amorphous phosphorus with chlorate of potash and other bodies rich in oxygen that, with phosphorus in this modification, mixtures of every degree of combustibility might be prepared. Among the matches which were experimentally prepared with such mixtures there were always a few which satisfied every requirement. Though the technical problem was thus by no means solved these experiments had at least proved the possibility of such a solution. To M. Hochstätter belongs the merit of having discovered the conditions for the industrial preparation with amorphous phosphorus of matches capable of superseding those containing the ordinary quality of phosphorus, even in the opinion of a prejudiced public, and which were capable of ignition on any at all suitable surface. The Hochstätter

\* Care must be taken not to let the ball of gold fall off the charcoal-slip on to the plate, as, if this takes place after the plate has got hot, the molten gold eats a hole in it. This is the only case in which I have found any damage done to the aluminium.

\* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

matches, indeed, leave nothing more to be wished for. They can be struck even upon cloth; they burn quietly, without noise or spitting, almost without smoke and smell, and very rarely fail, as the reporter has convinced himself by a prolonged trial.

These matches attract absolutely no moisture, and can therefore be used on shipboard and in all climates. What is still more important the workmen during their production are not exposed to danger of any kind soever; nor can they give rise to poisoning, intentional or accidental. They are also cheaper than the ordinary kind, since the mixture costs:—For those with sulphur, 0·8 shilling; for those without sulphur, 1·7 shilling; for wax-tapers, 1·42 to 2·0 shillings; whilst it is stated that in Germany the mixtures for the same number of ordinary matches cost respectively 1 shilling, 2 shillings, and 2·8 shillings.

The manufacture of these matches is without doubt the greatest improvement which has been effected in this trade since 1862, and the question now arises in how far it has become the serious duty of governments to listen to the many and important voices which for years, though unfortunately in vain, have urged the banishment of ordinary phosphorus from the match trade. Half measures—such as improved ventilation in factories, and the prohibition of glue in the composition of the mixture, because in that case it must be used hot—remove the evil only partially, or not at all. An attempt has been made to lessen the danger to which the workmen are exposed by reducing the proportion of phosphorus to a minimum. How ineffectual such endeavours have hitherto been appears from the circumstance that in some works even yet mixtures are employed with a proportion of phosphorus far exceeding the 6 or 7 per cent which in Austria is found amply sufficient.

Dr. Letheby proposed the use of oil of turpentine for the absorption of the vapours of phosphorus, and in the works of Black and Bell, at Stratford, near London, and more recently in several German establishments, each workman wears on his breast a vessel containing this oil. But this suggestion has by no means removed the pernicious effects of the vapour of phosphorus, since absorption still takes place through the skin and the clothing. It is also still an open question whether the vapours of phosphorus are rendered harmless by oil of turpentine, or if their smell is merely disguised. Such palliatives are often hurtful instead of useful. Those concerned allow themselves to be lulled into a feeling of security whilst the danger is still present.\*

When governments find it necessary to interfere in technical arrangements great caution is doubtless requisite, since an ill-timed regulation may increase certain evils instead of diminishing them. The question, however, now a perfect method of employing amorphous phosphorus in the manufacture of matches has been discovered, seems analogous to that of the poisonous Schweinfurt green, which governments who care for the physical well-being of their citizens did not hesitate to prohibit when once a complete substitute had been found in the shape of the new chrome green. Moreover, the opposition of manufacturers to the introduction of amorphous in place of ordinary phosphorus would not be very violent, since in an establishment which employs the common kind of phosphorus little alteration of plant would be needful.

Ordinary phosphorus can lay claim neither to economy, nor to a superior quality of the article produced, nor to greater convenience in the manufacture. On the contrary, quite independent of its absolute innocence in all these points, the amorphous modification has the advantage. In laying out new works there is further no occasion for costly and especial arrangements for ventilation, and for abnormally lofty work-rooms if the amorphous phosphorus is to be used.

The *Compagnie generale des Allumettes Chimiques*,

\* See W. Jettel, "Die Zündwaaren Fabrikation in ihrer gegenwärtigen Ausbildung." Brunswick: F. Vieweg. 1871.

which, by a recent French law, has obtained a monopoly of the match trade, will, it is to be hoped, not fail to set in this respect a good example, as on account of the concentration of the whole manufacture it would be easy for it to work this improved process to advantage.

As to the composition of the mixture used in Sweden for so-called safety-matches which ignite only on a prepared surface there prevails still some uncertainty, and it is possible that the formulæ used in different manufactories are not absolutely identical. According to Jettel, whose statement is based upon an analysis of the mixture performed by Kriwanek in the laboratory of Prof. Hlasiwetz, but has been slightly modified for actual use, its composition is the following:—

Glass	.. .. .	1½ part.
Glue..	.. .. .	1 "
Bichromate potash	.. .. .	4 "
Chlorate potash	.. .. .	6½ parts.
Oxide of iron..	.. .. .	½ part.
Black oxide of manganese	.. .. .	2 parts.
Sulphur	.. .. .	1 part.

According to Jettel the quantity of sulphur is given too high, the cause of which may possibly be that the matches were not genuine Swedish. Jettel considers that it should not exceed the half of the proportion as given above.

The composition of the friction-surface is:—

Glue	.. .. .	1½ part.
Umber	.. .. .	1 "
Manganese	.. .. .	4½ parts.
Sulphuret of antimony	.. .. .	16½ "
Amorphous phosphorus	.. .. .	10 "

Gentele has subsequently examined the composition of Swedish matches, and obtained very different results. He found:—

Chlorate of potash..	.. .. .	32 parts.
Bichromate of potash	.. .. .	12 "
Red lead	.. .. .	32 "
Sulphuret of antimony..	.. .. .	24 "

This mixture ignited readily upon a surface consisting of 8 parts of amorphous phosphorus with 9 parts of sulphuret of antimony.\*

It appears from the experiments of Gentele that slight differences in the composition of the mixtures have little effect upon the quality of the matches, if only the preparation has been careful, *i.e.*, if the separate ingredients have been ground as finely as possible, and intimately mixed, which applies also to phosphorus matches and to all similar mixtures. The selection and preparation of the wood are not a matter of indifference.

The endeavours to produce matches entirely free from phosphorus have continued without interruption since the investigations of Wiederhold,† which are of permanent value, and must be regarded as the basis of all subsequent enterprise in this direction. In the opinion of many they have not yet been so far improved as to be on an equality with phosphorus matches. They are still too hard to strike, diffuse an unpleasant odour, and have no advantage in cheapness. The non-phosphoric matches, however, recently produced on the large scale by G. Kalliwoda‡ are said to be totally or almost entirely free from these defects. This important problem may therefore be regarded as solved if prolonged experience confirms the above favorable reports.

According to C. Liebig a good mixture, free from phosphorus, may be prepared as follows:—

Sulphuret of antimony..	.. .. .	8 parts.
Chlorate of potash..	.. .. .	16 "
Red lead	.. .. .	10 "
Bichromate of potash	.. .. .	1 "
Nitro-mannite	.. .. .	8 "
Glass	.. .. .	4 "
Gum arabic	.. .. .	5 "

\* Gentele, *Dingl. Pol. Journ.*, ccix., 369.

† Wiederhold, *Jahresber. f. Technol.*, 1861, 622.

‡ Kalliwoda, *Deutsche Industrie Z.*, 1871, 17.

Particulars as to the value of this mass are unknown; it cannot be cheap and the preparation may not be free from danger.

Among the non-phosphoric mixtures must be included that suggested by Fleck, containing finely divided sodium diffused in paraffin.

As ingenious as are the methods proposed to counteract the unfavourable attributes of the sodium, this proposal will in all probability never be practically realised, especially as better agents are known.

For blasting charges under water Fleck's mixture might possibly be applicable, but the spontaneous decomposition which gradually sets in would be found a difficulty. E. Kopp\* has already called attention to its disadvantages, whilst Springmühl, after a careful examination, and also Jettel, deny that it possesses any practical value.

At the Exhibition France, Sweden, and Austria represented the match trade.

On behalf of France appeared the *Compagnie Générale des Allumettes Chimique*, formed in the month of October, 1872, and possessing the legal monopoly for the production of matches in the whole of France. For this privilege it pays to the Government a fixed tax of 16,000,000 francs as long as the consumption in France does not exceed 40 milliards. Beyond this consumption there is a progressive duty of 6 centimes per 100 matches. Hence this company alone represents the whole of the match trade of France. The former manufacturers, in expectation of the expropriation which they had daily to await, did not exhibit. The importance of this manufacture for France appears from the following figures.

The number of the (former) match-works in France, large and small, amounts to no fewer than 833. The inland consumption is on the average five matches daily per head, or 70 milliards yearly. The company must, therefore, meet the enormous daily demand of 180 millions without maintaining the old 833 works in activity. It has, therefore, decided to concentrate the production in twelve establishments, which will be distributed in the country according to the need of production and the convenience for procuring the necessary materials. It is of opinion that it will be possible to introduce into each of these works all those improvements, industrial and sanitary, which science has pointed out as requisite.

Of the 180 millions of matches daily required 150 millions are of wood and 30 millions of wax. The former require yearly 45,000 cubic metres of wood (oak, poplar, aspen, pine, and birch), 1200 to 1500 tons of roll-sulphur, and 300 tons of phosphorus (1 ton = 1000 kilos.). The 30 millions of wax-matches represent a yearly consumption of—

300,000 kilos. spun cotton.  
300,000 kilos. stearin.  
60 tons of phosphorus.

To this must be added the consumption of the other articles, such as red-lead, gum, &c., of which the company's report to the jury gives no account.

This daily production of 180 million matches requires above 6000 workpeople, both men and women. The varied, more or less elegant, pasteboard boxes are manufactured by the company, 3 millions being required daily, requiring a yearly consumption of at least 2500 tons of pasteboard of various qualities. As to the number of workpeople engaged in the production of these boxes the report gives no particulars, but we may conclude from other sources that about 12,000 persons of both sexes will suffice, to whom must further be added those employed in packing and sending off, to the number of at least 200 persons.

The above figures refer merely to the home consumption, but there is also a considerable exportation, not merely by sea, but even into other countries of Europe. The French marks, "Roche," "Causemille," "Meiffreu," are in request at La Plata, Buenos Ayres, Japan, Guatemala, Peru, &c. The exportation amounts to the yearly value

of 15 mill. francs, and consists exclusively of wax-lights and round wooden matches. The traffic of the *Société Générale* is therefore as follows:—

Domestic consumption ..	65,000,000 frs.
Exportation .. .. .	15,000,000 „
	80,000,000 „

Which is distributed as follows:—

Duty on consumption ..	35,000,000 frs.
Duty on exportation .. ..	1,800,000 „
Allowance to dealers .. ..	13,000,000 „
Cost of production and profit	30,200,000 „
	80,000,000 „

Finally, must be remarked that in the show-case of the company Coignet, Père et Fils, exhibit matches with a friction-surface of amorphous phosphorus.

In few countries has the manufacture of matches reached such a development, and is still making such progress, as in Sweden. Swedish matches are known in all civilised countries, and so valued that counterfeits are sold as Swedish. The exportation, which was only 1,114,677 kilos. in 1865, and 2,896,398 kilos. in 1870, rose in 1871 to 4,281,395, and in 1872 to 6,059,601 kilos. The requisite chemicals are imported from England. The works at Jönköping alone produce yearly matches of the value of 1½ million riksdaler (at 1 mark 14 pf. German), and the production of the remaining twenty-four establishments now in operation may be of equal value. Besides, there are some manufactories engaged solely with the manufacture of fusee-wire.

The largest establishment at Jönköping is the property of a joint-stock company. It was founded in 1845, and is driven by four steam-engines of the joint power of 76 horses. In 1872 there were employed 255 men, 849 women, 105 boys, and 141 girls, the two latter groups under eighteen years of age; together, therefore, 1350 persons. Of the workwomen, 668 were only periodically engaged in their own houses, and that with the manufacture of boxes.

The production is constantly increasing, and amounted in 1872 to 128,039,754 matches of different kinds, representing a value of 1,857,249 riksdaler. About four-fifths of the total production are exported. The company has founded a school, a reading-room, baths for the workpeople, and is now erecting cottages for their accommodation. It employs alone as many workpeople as all the rest of the Swedish match works, and paid in 1872 360,514 riksdaler in wages.

(To be continued.)

## ACTION OF ANHYDROUS ACIDS UPON ANHYDROUS BASES.

By M. J. BECHAMP.

It is still a question if the anhydrous acids, which certain modern chemists call anhydrides in order to deny altogether their acid function, are or are not acids. If we demonstrate that anhydrous acids, of whatever nature, are capable of uniting entirely with anhydrous bases, differing also in their nature, the theory of Lavoisier will receive a signal confirmation.

### I. Action of the Anhydrous Mineral Acids upon Anhydrous Mineral Bases.

M. Bussy has already shown that sulphate of baryta may be formed by bringing in contact anhydrous sulphuric acid and anhydrous baryta. Borate of lime may even be formed by projecting anhydrous lime into anhydrous boric acid in a state of tranquil fusion. The combination is accompanied with the evolution of heat and light.

\* Kopp, *Monit. Scientif.*, 1870, 74.

## II. Action of Anhydrous Organic Acids upon Anhydrous Mineral Bases.

The author has caused anhydrous acetic, butyric, and caproic acids to act upon anhydrous oxides of calcium, barium, lead, and mercury.

*Action of Anhydrous Acetic Acid upon Anhydrous Lime.*—The base mixed with an excess of absolutely pure acid is introduced into a green-glass tube: a thermometer is plunged in the mixture, and the tube is then sealed over the lamp. It is then heated to  $133^{\circ}$  in a bath for four hours. The internal temperature of the tube rises to  $141^{\circ}$ , and remains there for about twenty minutes. The mass increases in volume, and the lime is *slacked* in the anhydrous acid. The product, freed from excess of acid, and dissolved in water, crystallises like acetate of lime, and has its composition. Anhydrous acetic acid combines directly with anhydrous baryta at  $100^{\circ}$ . Anhydrous butyric and caproic acids combine directly with anhydrous lime at  $120^{\circ}$ . The quantity of the salts obtained, as calculated from the weight of lime employed, is almost theoretic. Anhydrous acetic acid unites completely with perfectly dry oxides of lead and mercury. The salts obtained, which are almost theoretic in quantity, when freed from excess of acid dissolve in water, and crystallise with their peculiar characters. In the experiment with oxide of mercury the temperature of  $105^{\circ}$  must not be exceeded. In an instance where this was done the substance was blackened, and the tube burst on being opened. This fact will be considered on a future occasion.

## III. Action of Anhydrous Mineral Acids upon Anhydrous Oxides of Organic Radicals.

The author has not experimented upon this particular case, affirmative instances being already known. MM. Dumas and Peligot obtained sulphate of methyl by the direct action of anhydrous sulphuric acid upon oxide of methyl. M. Wetherill produced sulphate of ethyl by passing the vapour of anhydrous sulphuric acid into anhydrous ether.

## IV. Action of Anhydrous Organic Acids upon the Anhydrous Oxides of Organic Radicals.

These combinations are obtained with difficulty, and the action of prolonged heat is required. M. Wurtz has combined directly oxide of ethylen with anhydrous acetic acid, obtaining ethylenic acetate and propyl-ethylenic acetates. The author has combined directly anhydrous butyric and acetic acids with anhydrous oxide of ethyl. The ethers obtained have the same characters and the same boiling-point as those obtained by the ordinary methods.

### TEST FOR SANTONIN.

By DAVID LINDO.

To the powerful agency of sulphuric acid we are indebted for many of the finest colour-tests in chemistry. I refer to those tests employed for the identification of certain organic substances, which are first dissolved in concentrated sulphuric acid, and other agents applied to them afterwards.

I have lately endeavoured to discover tests for some organic compounds for which at present very few or no characteristic reactions are known. If the substance will dissolve in sulphuric acid without charring, I always try the effect of different agents on this solution. It was in seeking a test for carbolic acid by this method that I met with the reaction previously published, and which I have proposed also as a test for nitric acid.

I have since been occupied with santonin. So far as I have been able to ascertain we possess no characteristic tests for this substance. As it is extensively employed out here, and I have no doubt in other places also, and as large doses are said to produce symptoms of irritant poisoning, a good test for it might prove acceptable.

I experienced great difficulty with this substance for a long time. Its almost neutral chemical properties, and the facility with which it decomposes into products of a dark brown colour, rendered it very unmanageable. At last I fell upon a reaction which seems to be fairly sensitive; it appears also to be very characteristic. The following is the test, and method of applying it:—

Place the santonin in a small deep porcelain dish, and dissolve it (without heat) in concentrated sulphuric acid. Rubbing the crystals down with a glass rod greatly facilitates solution. Add highly dilute solution of perchloride in small quantities at a time, and between each addition give the dish a pretty quick rotatory motion while it is supported on a table. A fine red colour is first developed, which changes to a magnificent purple, and then to a splendid violet as the sulphuric acid becomes more dilute. The heat produced by mixing the fluids is necessary to develop the colours.

When applying the test to small quantities of santonin a somewhat different method of proceeding must be adopted. The experiment in this case is best performed in a 1-inch shallow porcelain capsule, with a thick flat bottom. Mix the highly dilute solution of perchloride of iron with an equal bulk of concentrated sulphuric acid, and add the mixture to the santonin. Heat must then be cautiously applied. The crystals of santonin will slowly dissolve, and the colour will be developed.

The capsule is conveniently supported on the blade of a spatula, and heated by a spirit-lamp.

One drop of a solution of 1 grain of santonin in 1 fluid ounce of chloroform was evaporated to dryness in a small capsule, and the residue heated with a drop of the perchloride of iron and sulphuric acid mixture. A very fine reaction was obtained.

The separation of santonin, however, from other organic matters would in most cases be a very difficult—and in many instances an impossible—thing to accomplish, owing to the facility with which it suffers decomposition.

In trying the experiment of separating santonin, by means of chloroform, from a powder containing rhubarb and santonin, I noticed a thing which I have not seen mentioned before. The chloroform separated from the powder by filtration was evaporated to dryness, and the residue tested for santonin. The violet colour was obtained very distinctly. I then tried the effect of the test-fluid on the colouring-matter of rhubarb alone, as I noticed this is dissolved by chloroform. The test produced a reddish colour, not the violet or purple colour of santonin.

Thinking that in the case of rhubarb the iron had nothing to do with the reaction, I next tried the effect of concentrated sulphuric acid alone on the colouring-matter of rhubarb. I found it produced a beautiful scarlet colour: this is much the same effect (as is very well known) produced by alkalis on the colouring-matter; and when the latter has been turned red by an alkali an acid restores it to yellow.

Falmouth, Jamaica,  
October 6, 1877.

## PROCEEDINGS OF SOCIETIES.

AKADEMIE DER WISSENSCHAFTEN, VIENNA.

July, 1877.

G. GOLDSCHMIDT, "*Idryl*." This body, found by Bödeker in Idria, is ascertained to consist of several hydrocarbons, which are separated from each other in the form of picrates. Besides chrysen, pyren, anthracen, phenanthren, a new hydrocarbon,  $C_{15}H_{10}$ , was isolated, and receives the name originally applied to the mixture.

G. CIAMICIAN, "Distillation of Resins and Resinous Acids with Zinc Dust." Aromatic bodies exclusively result from the experiments. Abietic acid and colophony both yield toluen, ethyl-methyl-benzen, naphthalen, methyl-naphthalen, and methyl-anthracen. Gum-benzoin gives rise chiefly to toluen, accompanied by small amounts of xylen, naphthalen, and methyl-naphthalen.

E. v. SOMMARUGA obtains by the "Action of Ammonia on Isatine" under pressure, isatine-diamide,  $C_{16}H_{12}N_4O_2$ , oxy-di-imido-diamido-isatine,  $C_{16}H_{14}N_6O_3$ , and desoxy-imido-isatine,  $C_{16}H_{11}N_3O_2$ . These compounds render it probable that the molecular formula of indigo,  $C_8H_5NO$ , should be doubled.

H. SKRAUP gives for the "Formula of Cinchonin"  $C_{19}H_{22}N_2O$ , as formerly asserted by Laurent, instead of the present one,  $C_{20}H_{24}N_2O$ , on the ground of a large variety of analyses of the carefully purified base and its salts. The amount of  $KMnO_4$  requisite for oxidation to cinchotenin and formic acid,—



corresponds likewise to this formula. A base,  $C_{19}H_{24}N_2O$ , was separated from the more soluble part of commercial cinchonin, and is evidently hydro-cinchonin.

G. NIEDERIST, "Action of Water on the Halogen Compounds of the Alcohol Radicals." By heating with an excess of  $H_2O$  at  $100^\circ$  the author easily changes these compounds into the corresponding alcohols, methyl-iodide into methyl-alcohol, allyl-iodide into allyl-alcohol, ethylen-bromide into ethylen-glycol, &c.

L. HAITINGER obtained by the "Action of  $HNO_3$  on Trimethyl-carbinol," nitro-butylen,  $C_4H_7NO_2$ , which forms a sodium compound,  $C_4H_6NaNO_2$ , of an explosive character.

A. LIEBEN and S. ZEISEL, "Action of Saline Solutions on Aldehyds." Propionaldehyd yields a condensation product,  $C_6H_{10}O$ , possessing the characteristics of an aldehyd, boiling at  $137^\circ$ , and forming an acid by oxidation.

G. CIAMICIAN, in a study on the "Spectra of the Chemical Elements and their Compounds," comes to the same conclusion as Lockyer, that the spectra of compounds, as well as those of the first order of elements, consist exclusively of bands; and, further, that the bands belong to molecules and the lines to free atoms. From a comparative examination of the spectra of thirty-one elements the author concludes that the lines in the spectra of chemically allied elements correspond to each other individually or in groups, each chemical group having its characteristic spectra, the spectra of the various individuals differing from each other in a change of position of homologous lines, and the wave-lengths of these homologous lines corresponding to the chemical power of the element, a greater wave-length accompanying a more intense chemical power.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 18, October 29, 1877.

The Telephone of Mr. Graham Bell.—M. Breguet.—A short illustrated description of this instrument. The author remarks that of all known telegraphs it is the one which acts under the influence of the feeblest currents.

Experiments on the Disruptive Discharge made with a Chloride of Silver Battery.—MM. Warren de la Rue and H. W. Müller.—An account of results, which have been described in detail in a paper read before the Royal Society.

Rheostatic Machine.—M. G. Planté.—This paper would be unintelligible without the accompanying illustration.

Action of Anhydrous Acids upon Anhydrous Bases.—M. J. Béchamp.—(See page 221.)

Determination of Reductive Sugar contained in Commercial Products.—M. Aimé Girard.—The reductive sugar pre-existing in the sample is first determined directly. To this end, after having raised to a boil 100 c.c. of a well prepared cupro-potassic liquor, resisting this test, the author pours into it quickly a known volume of the saccharine solution, so large that a part only of the cupro-potassic liquor may be decomposed. The mixture is kept at a boil for a minute or two, and as soon as the precipitate of suboxide has taken the fine red tint characteristic of the granular state it is thrown upon a rapidly-acting filter, and washed with boiling water till the washings are no longer alkaline. The filter is then folded up, placed in a large platinum boat, dried rapidly over the gas-lamp, and burnt in the air. After cooling, the boat is reduced into a glass tube, and reduced in a current of pure hydrogen. The determination of the reductive sugar and the saccharose taken together is effected in the same manner after inversion. Another portion of the saccharine solution, mixed with hydrochloric acid, kept in the water-bath according to the indications of Clerget, then diluted with water, and boiled for a few moments after dilution, is in the same manner brought in contact with an excess of the cupro-potassic liquor, the suboxide is collected, washed, dried, burnt, and lastly reduced by hydrogen. From the weight of copper furnished by the first operation it is easy to deduce the weight of the reductive sugar. 1 grm. of reduced copper corresponds to 0.569 grm. of reductive sugar. As for the weight of copper furnished by the second operation, after having deducted the weight corresponding to the pre-existing reductive sugar, and having applied to the remainder the proportional correction required by the difference of the equivalents of reductive sugar and of saccharose, a correction represented by  $\frac{1}{171}$ , the weight of the saccharose contained in the sample is calculated.

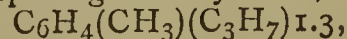
Reductive Sugar of Commercial Products in its bearings upon Saccharimetry.—M. H. Morin.—Not adapted for abstraction.

Production of Racemic Acid in the Manufacture of Tartaric Acid.—M. E. Jungfleisch.—Without denying that certain vines may produce racemic acid under unknown conditions, the author holds that this substance, when met with in manufactories, takes its rise under the joint action of heat and alumina, or an analogous oxide.

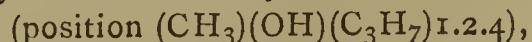
Certain Physical Properties of Quercite.—M. Prunier.—An account of the crystallographic characters of quercite, its action upon polarised light, and its specific gravity.

*Journal für Praktische Chemie.*  
Nos. 9 to 13, 1877.

On Quinons.—E. Carstanjen.—The author has rendered a valuable service to our knowledge of the structure of quinons by preparing from cymene,—



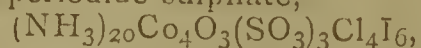
a quinon and an oxyquinon identical with those derived from thymol,  $C_6H_3(CH_3)(OH)_3(C_3H_7)1.3.4$ . Cymophenol, the only isomeride of thymol—



yields, upon being subjected to the same processes of oxidation, successively  $C_{10}H_{12}O_2$  and  $C_{10}H_{12}O_3$ , compounds perfectly identical with thymo-quinon and oxy-thymo-quinon. The results would support the opinion that the oxygen atoms in quinons cannot occupy the meta-position, and tend to show that they do not occupy the positions of both the amido groups of the diamido compound from which oxythymo-quinon is directly formed, but that the HO group and one amido group unite to form

the quinon, the other amido group being replaced by a new hydroxyl.

**Acid Periodides.**—S. M. Jørgensen.—A purpureo-cobalt-chloride-periodide-sulphate,—

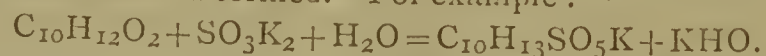


is obtained by adding a solution of I in HI to the solution of acid sulphate of purpureo-cobalt-chloride. The olive-green crystals are not very stable, decomposing in the air and in the aqueous solution. Similar compounds are formed with the radical  $4\text{NH}_3\text{Pt}$ . As these acid periodides show the same physical characteristics as the iodides of potassium-platinum cyanides, the author regards them as well-defined bodies, not molecular compounds, explaining their structure on the theory of the polyvalence of iodine. An appendix contains the crystallographic properties of a number of periodides.

**Thermo-chemical Investigations** (xxiv. Platinum and Palladium).—J. Thomsen.—The author gives a detailed account of a variety of experiments on the various salts of these metals, accompanied by tables of the results. They coincide with the chemical deportment of Pt and Pd, the former showing the greatest stability in the tetratomic compounds, the latter in the diatomic.

**Signs of the Times.**—II. Kolbe.—The editor of the journal attacks, in no measured language, a recent *brochure* by J. H. van't Hoff, on "The Position of Atoms in Space," as well as the recommendation of it by Prof. Wislicenus. The work is regarded as characteristic of the present time, when there is not only a poverty of criticism, but a hatred of it; and resultant from the increasing lack of general culture, as well as of thorough scientific training on the part of professors of chemistry. "It is in consequence of this, that that trivial, fatuous natural philosophy, with its profound intellectual air, which fifty years ago was thrown to one side by exact investigators, is at present rescued by pseudo-philosophers from the lumber-room harbouring the hallucinations of the human mind, and the attempt made to smuggle it—like a painted and bedizened courtesan—into society where it has no right."

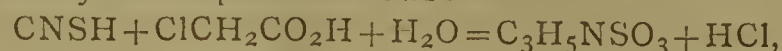
**Action of  $\text{K}_2\text{SO}_3$  on Quinons.**—E. Carstanjen.—A reaction ensues at once when the solutions are brought together, and the potassium salt of the hydroquinon-sulphonic acid is formed. For example:—



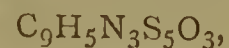
**Thermo-chemical Investigations** (xxv. Magnesium, Calcium, Strontium, and Barium).—J. Thomsen.—The results of the experiments show that not only the physical, but the thermo-chemical properties of the compounds of these four metals alter regularly with the atomic weights. With an increase in the atomic weight, increase—(1) the stability of the oxy-hydrates, and the thermal development by union with  $\text{H}_2\text{O}$ ; (2) the solubility of the hydrates in water, and the heat of solution of the same; (3) the heat of union of the chlorides, bromides, iodides, nitrates, and sulphates. With an increase in the atomic weight, decrease—(1) the affinity of the five mentioned salts to  $\text{H}_2\text{O}$ , the amount of water of crystallisation, and the amount of heat developed in uniting with it; (2) the solubility of these salts, the heat developed in solution, and their deliquescence in moist air. The atomic weight is entirely unconnected with the heat of neutralisation when the hydrates are dissolved in water, and with the total amount of heat connected with their formation. With regard to the salts of the same metal with Cl, Br, and I, it was found that with an increase of the atomic weight of the electro-negative element, the heat of formation of the haloid compounds decreased, while the affinity to water, the heat of union with water of crystallisation, the solubility, the heat of solubility, and the deliquescence increased. Of all metals Mg, Ca, Sr, and Ba developed the greatest amount of heat in the formation of the hydrate from I at metal. They show also the greatest affinity for O of all elements thus far examined, and

approach the alkaline metals very nearly in affinity to Cl.

**Action of Monochlor-acetic Acid on Sulpho-cyanic Acid and its Salts.**—M. Nencki.—The reactions were undertaken with the view of comparing them with the results obtained from the isomeric sulpho-urea, which yields glycolyl-sulpho-urea. Aqueous solutions of CNSH are easily acted upon as follows:—



forming carbamine-sulpho-acetic acid, which is easily dissolved and crystallised. It forms no salts, decomposing in the presence of metallic oxides into cyanic acid and sulpho-glycollic acid. The reaction between  $\text{CNS.NH}_4$  and  $\text{ClCH}_2\text{CO}_2\text{H}$  is very violent, and gives rise to rhodanic acid,  $\text{HS.CH}_2\text{CO.S.NC}$ , a finely crystallising body, which yields, with solutions of metals possessing a strong affinity for S, mixtures of simple and double salts. It is easily changed by weak oxidisers into rhodanin red,—



which imparts a brilliant intense orchil-red to fabrics, and a violet dye-stuff not yet analysed. The present expense of preparing mono-chlor-acetic acid unfortunately prevents the practical application. Blue and yellow dye-stuffs have likewise been obtained from rhodanic acid.

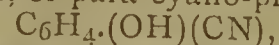
**Action of Mono-chlor-acetic Acid on the Sulpho-cyanates of Aromatic Monamines.**—J. H. Jäger.—Aniline and toluidin give rise to analogous bodies of the general formula—



which have acid characteristics, but form no salts. Their constitution is evidently quite different from that of the rhodanic acid mentioned above, the compounds decomposing in contact with acids into phenyl- or toluyl-carbamide and sulpho-glycollic acid.

**Benzoyl-carbonic Acid.**—H. Kolbe.—The author, after recounting the history of the priority of his discovery of the preparation of propionic acid from the action of HKO on  $\text{C}_2\text{H}_5\text{CN}$ , in connection with Frankland as opposed to the claims of Dumas, criticises sharply the names used by Claisen, and Hübner and Buckler in their recent discovery of  $\text{C}_6\text{H}_5\text{COCOOH}$  (CHEM. NEWS, xxxv., 142, 217). The appellations "phenoxylic," "phenylglyoxylic," "aromatic pyruvic acid," and a "true ketone acid" are regarded as scientifically incorrect. Benzoyl-carbonic acid and formyl-benzoic acid he considers the correct terms for the two acids  $\text{C}_6\text{H}_5\text{COCOOH}$  and  $\text{C}_6\text{H}_4(\text{OCH})\text{COOH}$ , both of which are regarded as possible.

**Derivatives of Paroxy-benzoic Acid.**—O. Hartmann.—The author prepares potassium phenylate in large quantities, by a rapid evaporation of a mixture of HKO and phenol, and interruption at the right moment. The preparation of paroxy-benzoic acid from the treatment of  $\text{C}_6\text{H}_5\text{OK}$  with  $\text{CO}_2$  is so simplified that it is as practical as the present methods of manufacturing salicylic acid. A number of salts are carefully described. Paroxy-benzamide was prepared from the ethylic ether by means of  $\text{NH}_3$ , and found to crystallise well, uniting with both acids and bases. By distillation with  $\text{P}_2\text{O}_3$  the amide yields paroxy-benzo-nitrile, or para-cyano-phenol,—

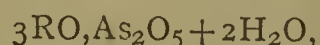


which resembles greatly the meta-cyano-phenol of Griess, but is entirely different from the salicylimid of Limpricht.

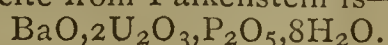
**Action of Cyanogen on Albumen.**—O. Loew.—By varying the amount of  $\text{C}_2\text{N}_2$  passed through a solution of albumen, the author obtains additive compounds of  $2\text{CN}, 3\text{H}_2\text{O}$ , of  $4\text{CN}, 8\text{H}_2\text{O}$ , and of  $8\text{CN}, 16\text{H}_2\text{O}$  with albumen ( $\text{C}_{72}\text{H}_{112}\text{N}_{18}\text{SO}_{22}$ ), which lose in the presence of alkalis a part of their cyanogen and  $\text{H}_2\text{O}$ , and give rise to peculiar bodies rich in N. When an excess of  $\text{C}_2\text{N}_2$  was used, a group,  $\text{C}_{14}\text{H}_{23}\text{N}_{11}\text{O}_{10}$ , oxamoidine, was separated from the albumen molecule.

**Osmium Oxysulphides.**—E. v. Meyer.—Two of these compounds,  $\text{Os}_3\text{S}_7\text{O}_5 \cdot 2\text{H}_2\text{O}$  and  $(\text{OsSO}_3)_2 \cdot 3\text{H}_2\text{O}$ , were obtained by passing  $\text{H}_2\text{S}$  through a solution of osmic acid. They are extremely unstable, and form with  $\text{NH}_3$  compounds which do not lose their N below  $200^\circ$ .

**Mineral Analyses.**—C. Winkler.—Roselith,—



is found not to contain  $3\text{H}_2\text{O}$ , as asserted by Skraup. A new member of the calcite group, cobalt spar, consisting of nearly pure  $\text{CoCO}_3$  has been found at Schneeberg. The mineral termed bismutho-spärite is ascertained to be pure carbonite of bismuth,  $\text{Bi}_2\text{O}_3\text{CO}_2$ . The composition of the urano-circite from Falkenstein is—



**Oxysulpho-arsenite of Barium.**—L. F. Nilson.—A compound of this character was found in the mother-liquor from which the salt,  $2\text{BaS} \cdot \text{As}_2\text{S}_3 + 5\text{H}_2\text{O}$ , had separated. Its composition is  $5\text{BaS} \cdot 2\text{As}_2\text{S}_2\text{O} + 6\text{H}_2\text{O}$ , and it is the first evidence of the existence of an oxy-sulphide of the trivalent arsenic.

*Reimann's Färber Zeitung,*  
No. 38, 1877.

This issue contains nothing of general scientific interest.

No. 39, 1877.

The principal article in this issue is an account of the carbonisation of the vegetable impurities in wool by means of chloride of aluminium, prepared, it is said, by the double decomposition of barium chloride and aluminium sulphate. The precipitated sulphate of alumina, *blanc fixe*, is used not merely as a pigment, for finishing white cottons and linens, in the paper manufacture, &c., "but—*horribile dictu*—even for the adulteration of flour."

No. 40, 1877.

The leading article in this issue is devoted to the denunciation of a Belgian manufacturer who is charged with having forged Dr. Reimann's signature to a circular which he has issued.

A report, said to have originated in England, is being spread to the effect that arsenious acid dissolved in glycerin is now used as a mordant for a black dye upon cotton.

## MISCELLANEOUS.

**Society of Arts.**—The programme of the arrangements for the coming session has just been issued. The opening meeting will be held on the 21st inst. At the second meeting, on the 28th, a paper will be read on "The Telephone," by Prof. Bell, the inventor, and among the other papers to be read before Christmas is one on "Freedom in the Growth and Sale of the Crops of the Farm considered in its Bearings upon the Interest of Landowners and Tenant Farmers," by J. B. Lawes, F.R.S. Three courses of "Cantor Lectures" are announced:—First course, on "The Manufacture of Paper," by William Arnot, F.C.S.; second course, on "The Application of Photography to the Production of Printing Surfaces and Pictures in Pigment," by Thomas Bolas, F.C.S.; third course, on "Some Researches on Putrefactive Changes, and their Results in Relation to the Preservation of Animal Substances," by B. W. Richardson, M.D., F.R.S. The second and third courses do not commence till after Christmas, as is also the case with the first meetings of the Chemical, African, and Indian Sections. An additional course of three lectures, on "Explosions in Coal Mines," is to be delivered by T. Wills, F.C.S., on three evenings in January and February. It is stated that the conference on "Health and Sewage of Towns" is to be repeated, and that a second "Congress on Domestic Economy" will be held this year at Manchester.

**Iridescent Glass.**—Those of our readers who have time for gazing into shop-windows must have noticed a recent addition to our fictile manufactures of a number of ornamental vases, cups, bowls, &c., of clear white glass, covered with beautiful iridescent films of different colours, and marked at unconscionably dear prices. At first it was thought that the process consisted in submitting the glass to the action of a deoxidating flame, and that the colours—like those tiresome black shams that would always disfigure our first attempts at test-tubes—was caused by the reduction of the lead; but the specification of the patent tells a different story. The inventor of the process is M. L. Clémandot, a French civil engineer, who has patented it in France, England, and America. The principle of the process appears to consist in submitting the glass vessels to the action of dilute hydrochloric, sulphuric, or other acid, under a pressure of from two to six atmospheres. M. Clémandot claims to be able to imitate the beautiful nacreous films on ancient glass which has been submitted to the combined action of air and water for two or three thousand years; but the ornamental vessels already exhibited, although very pretty, are a long way off the poorest specimens of Assyrian or Egyptian glass in any ordinary collection. Time is evidently an important factor in bringing about this singular change. In any case M. Clémandot's productions are very beautiful, but we do not see why they should fetch such exorbitant prices.

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# THE CHEMICAL NEWS.

VOL. XXXVI. No. 939.

## VOLUMETRIC ESTIMATION OF SULPHURIC ACID IN WATERS.

By P. HAUBST, Dr. Phil.

ALTHOUGH, for sanitary purposes, an opinion of the character of a natural water may be formed without the estimation of all its mineral ingredients, and especially of sulphates, it is highly desirable in many cases—for brewing, as an instance, and other manufacturing purposes—to find by an easy and ready method the exact amount of sulphuric acid bound to alkalies, as well as that present as calcic and magnesian sulphates.

In the following lines I shall give a short description of a volumetric method which enables, in a few hours, to ascertain accurately the quantity of sulphuric acid combined with fixed alkalies and with earthy metals.

As water charged with alkaline carbonates cannot have any other salts of earthy metals but carbonates, all the sulphuric acid present is consequently in combination with alkalies. The standard solutions employed are centinormal oxalic or sulphuric acid, and, if thought necessary, centimormal ammonia.

The process is divided into two operations:—Estimation of sulphuric acid in the alkaline sulphate; then estimation of the whole sulphuric acid, the difference being that in combination with earthy metals.

Take 100 c.c. of the water (if sodic and potassic carbonates be present neutralise with dilute hydrochloric acid); add a slight excess of baryta water; then pass in a current of carbonic gas, or mix with it water highly charged with this gas; let it boil for a few minutes, and filter. The precipitate is washed with boiling water till the washings are neutral to test-paper; and the filtrate, which contains now the alkalies as carbonates, is titrated with the above-mentioned centinormal oxalic or sulphuric acid.

The amount of acid consumed is exactly the same as that originally combined with potash and soda. Lime and magnesia salts having been precipitated as carbonates cannot interfere with the process.

Simultaneously with the first operation the second part may be carried on. The same number of cubic centimetres is taken, raised to boiling, carbonate of soda added till the liquid remains distinctly alkaline. It is then, after some minutes ebullition, passed through a small filter and well washed. All the sulphuric acid present is now in combination with potash and soda; lime and magnesia salts, having been converted into carbonates by the action of the sodic carbonate, are filtered out.

A sample of brewing-water, which in its natural state contained several grains per gallons of sodic carbonate, after having been charged with gypsum, showed the following results:—

Quantity Operated upon, 100 c.c.		
		Centinormal Oxalic.
Used in the 1st operation	.. ..	31.4 c.c.
Used in the 2nd operation	.. ..	71.0 "
Rests	.. ..	39.6
		Grains per Gall. of SO <sub>3</sub> .
31.4 c.c. centinormal oxalic corresponds to		8.79
71.0 "		19.88
39.6		11.09

The whole sulphuric acid amounted, therefore, to 19.68 grains per gallon, 8.79 grains of which were combined with potash and soda, 11.09 grains with lime and magnesia.

I may state, in addition, that the quantity of SO<sub>3</sub> found by the usual method was 19.67 grains.

Southampton, November 11, 1877.

## DESTRUCTION OF LEATHER BY GAS.

By GEORGE E. DAVIS.

NOTICING the communication by Prof. Church on the above subject in the CHEMICAL NEWS, vol. xxxvi., p. 179, I give the following results of some experiments commenced two months ago upon the same subject.

More than two months ago one of my clients brought me some books (cash-books) which had been in daily use from 1855 to 1858 in a large office in Manchester. In the beginning of 1858 they were placed uncovered upon a shelf near the ceiling, where they remained until August, 1877. These books had been strongly bound in rough calf, and had red-basil lettering-pieces. Upon knocking the books, the leather from the backs came off as a mixture of dust and small pieces, which were very acid to test-papers.

Some of the leather carefully scraped from the back was treated with hot water, when it yielded a substance more nearly resembling india-rubber than anything else I have ever seen; this, though, only when wet, for when dry the mass was very brittle and easily powdered.

The aqueous solution contained:—

	Per cent.
Combined SO <sub>3</sub> .. ..	2.847
Free SO <sub>3</sub> .. ..	1.920

The red-basil lettering-piece was next examined, and found not altered much in strength, though it had suffered somewhat. The leather on digestion with water had evidently undergone but little change, as the pieces retained their shape; the aqueous solution contained:—

	Per cent.
Combined SO <sub>3</sub> .. ..	0.99
Free SO <sub>3</sub> .. ..	0.87

The piece of leather underneath the letter-piece was next examined, as it was thought that the lettering-piece would have acted as a filter and kept back the SO<sub>3</sub> from the leather beneath it. It was very strong, though perhaps not quite as strong as new leather, and when treated with water the filtrate contained:—

	Per cent.
Combined acid .. ..	0.39
Free acid .. ..	0.76

Now, knowing that all bookbinders use alum in the paste and that rough calf is tough to work, and therefore the paste is often put on in excess and allowed to soak in, it was thought advisable to examine another book in rather a different manner.

The back was scraped off and treated as before; part was boiled with soda, when it yielded 1.32 per cent of ammonia.

	Per cent.
Combined acid .. ..	3.46
Free acid .. ..	2.18

The red-basil lettering-piece gave—

	Per cent.
Ammonia .. ..	1.28
Combined acid .. ..	0.87
Free acid .. ..	1.04

Here it will be seen that the ammonia is in excess of the acid necessary to form a sulphate; but it must be remembered that *all* lettering-pieces were in those days glaired over with "glair," or white of egg.

A large piece was cut from the side of the book, and this side was not freely exposed to the air during the twenty years it remained on the shelf; therefore it only received the products of combustion, due to the circulation of air through the pile of books. This piece from the side gave:—

	Per cent.
Ammonia .. .. .	0.46
Combined $\text{SO}_3$ .. .. .	1.85
Free $\text{SO}_3$ .. .. .	0.64

I am now repeating these experiments upon new leather, the results of which I will communicate when finished.

Barton Arcade, Manchester,  
October 26, 1877.

## ACTION OF SULPHURIC ACID AND OXIDISING AGENTS ON MORPHIA AND ITS SALTS.

By DAVID LINDO.

OF the various tests for morphia the colour produced by oxidising agents does not appear to have met with the attention it deserves. The well-known tint produced by adding nitric acid to the alkaloid or its salts is evidently the result of oxidation.

When the action of the acid is controlled in a manner to be presently described, a much deeper and more permanent red colour is developed than can be obtained by applying the test in the ordinary way. Fresenius quoting from Otto makes the following reference to this modification of the nitric acid test.

"If morphia, or a compound of morphia, is treated with concentrated sulphuric acid and heat applied, a colourless solution is obtained; if, after cooling, 8 to 20 drops of sulphuric acid mixed with some nitric acid are added, and 2 or 3 drops of water, the fluid acquires a violet-red colouration; gently heating promotes the reaction."

He then goes on to describe the further action produced on the addition of binoxide of manganese, or chromate of potash, either of which it is stated will develop a deep mahogany brown colour in the mixture. The reaction with nitric acid and other oxidising agents can be produced in the following simple manner:—

Place a grain of morphia or any of its salts (I used the muriate in my experiments) in a small porcelain dish, add 20 minims of pure concentrated sulphuric acid, and apply a gentle heat for a few seconds. Let the mixture cool a little, then add cautiously 60 minims of distilled water. If a drop of this mixture is placed on a white porcelain surface and touched with a slender glass rod moistened with nitric acid, a beautiful deep red colour will be developed, which remains unchanged for a considerable length of time.

The reaction is not confined to nitric acid; every oxidising agent I have tried produces the same red colour if applied to a solution of morphia in sulphuric acid prepared as above. All the following substances can be used in this way as tests for morphia. Iodic acid, ferricyanide of potassium, bichromate of potash, chlorate of potash, and most of the nitrates.

These reagents are best applied in small quantities in the solid state. Bin oxide of manganese, peroxide of gold, and peroxide of lead can also be used.

It is indispensable that the concentrated sulphuric acid should be allowed to act on the morphia, or its salt (aided by a gentle heat), before water is added, for if the alkaloid or its compound is dissolved at once in dilute sulphuric acid, the reagents will produce little or no effect on the solution.

If the tests are applied to a solution of morphia (or its salt) in concentrated sulphuric acid, to which solution no water has been added, some of them will not act at all, and others will produce reactions which are very well known

already. On adding iodic acid, for instance, iodine will be set free; and a green colour will be developed with bichromate of potash from reduction of the chromic acid.

The smallest visible quantity of morphia or its salts in the dry state can be tested by the method I have proposed. It is merely necessary to heat the particle gently with a small drop of sulphuric acid, add 2 drops of water afterwards, and apply any of the oxidising agents named above to the solution.

I give the preference to iodic acid, ferricyanide of potassium, nitric acid, and the nitrates; when the latter are used it is sometimes necessary to apply a gentle heat.

Falmouth, Jamaica,  
October 18, 1877.

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, November 15, 1877.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

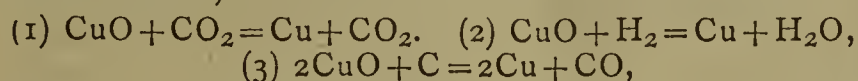
AFTER the announcement of visitors and presents to the library, and confirmation of minutes, the following certificates were read for the first time:—T. C. Cloud, G. F. Dowdeswell, A. Ginders, A. Linnell, D. A. Louis, S. P. Pickering, and J. Woodland.

The PRESIDENT then announced that Professor Odling being unable to attend, his paper on Gallium would be postponed till the next meeting of the Society.

The following papers were read:—

"First Report to the Chemical Society on some points in Chemical Dynamics," by Dr. WRIGHT and Mr. LUFF. From certain theoretical considerations the authors thought it probable that the temperature at which a body A begins to act on a compound BC in accordance with the reaction  $A + BC = AB + C$  is a function of  $a$ , the physical condition of the substances,  $b$ , the heat disturbance (evolution or absorption) taking place during the change; and  $c$  the chemical habitudes of the bodies, possibly expressible as numerical values constant for each substance. An elaborate series of experiments has therefore been made to find out the temperatures at which the actions of carbonic oxide, hydrogen, and free amorphous carbon on oxide of iron or oxide of copper are first perceptible. Various specimens of oxides in different states of physical aggregation were prepared, in some instances by special devices so as to obtain products free from all traces of organic matters derived from washing-water, filters, &c. The temperatures at which carbonic oxide begins to act on these bodies were determined by keeping portions of them in a tube at various temperatures, passing pure carbonic oxide (carefully freed from admixed oxygen—from air) over them, and noting the temperature at which the issuing gases first rendered baryta-water turbid. The temperature of initial action of hydrogen was obtained by dissolving the substances, after exposure to its action, in hydrochloric acid, or hydrochloric acid and ferric chloride, and testing by permanganate or ferricyanide. The temperatures at which carbon begins to act were found by observing when gas began to be evolved on heating in a Sprengel vacuum, due corrections being made for small quantities of carbonic oxide and carbonic acid occluded by the carbon, and gradually given off by it during heating. Two kinds of carbon were used—one a dense sugar-charcoal, well roasted, ignited in a current of chlorine, and again heated in a closed platinum crucible till no more hydrochloric acid came off; the other, a light pulverulent carbon obtained by acting on ferric oxide with carbonic oxide at about  $400^\circ \text{C}$ ., and dissolving out the reduced iron by hydrochloric acid. The general results of these

experiments are as follows:—(1) The temperature at which the action of a given reducing agent on a given metallic oxide is first perceptible depends on the physical condition of the metallic oxide, and, if carbon be the reducing agent, also on the physical condition of the carbon. (2) Hydrogen uniformly begins to act on a given oxide in a given physical state at a lower temperature than carbon, and carbonic oxide begins to act at a lower temperature than hydrogen. (3) When the physical state is about the same, a given reducing agent begins to act on copper oxide at a lower temperature than on iron oxide. (4) The two last conclusions are special cases of the general rule that *the greater the algebraic value of the heat disturbance (i.e., the more heat evolution or the less heat absorption) the lower the temperature at which the action is first noticeable.* (This rule is, however, not general for all metallic oxides, as it does not apply in the case of iron and tin oxides.) Thus in the case of the reactions—



there is respectively an evolution of heat to the extent of +30.05, +19.52, and +9.48 kilogrm. heat units per 16 grms. of oxygen transferred from metallic oxide to reducing agent. In the corresponding actions of these agents on  $\text{Fe}_2\text{O}_3$  the heat disturbances are +1.90, -8.63, and -18.67. In the reduction of cuprous oxide there is almost the same heat disturbance as in that of cupric oxide (by the same reducing agent.) Hence the temperature of initial action on  $\text{Cu}_2\text{O}$  of each agent lies very close to that found for  $\text{CuO}$ , in fact within the limits afforded by variations in physical state. The action of carbonic oxide on precipitated cupric oxide is noticeable at a temperature much lower than  $100^\circ$ ; at  $100^\circ$  carbonic oxide is wholly converted into carbonic acid by heating it in sealed tubes with some oxide. By passing carbonic oxide over cupric oxide at  $100^\circ$  pyrophoric copper is soon obtained almost free from oxide. If the carbonic oxide contain a trace of air, the partially reduced oxide serves as a conveyer of oxygen to the carbonic oxide, thus producing much more carbonic acid than that due to the cupric oxide acted on. The actual temperature values obtained with chief specimens examined are given in the following table:—

Substance.	Initial Temp. of Action with—			
	CO.	H.	Sugar C.	C frm. CO.
Copper oxide by precipitation	$60^\circ$	$85^\circ$	$390^\circ$	$350^\circ$
Ditto by ignition of nitrate..	125	175	430	390
Ditto, prolonged heating of	146	172	440	430
metal .. .. .				
Cuprous oxide .. .. .	110	155	380	345
Ferric oxide, by calcining	202	260	450	430
$\text{FeSO}_4$ .. .. .				
Ditto, precipitated .. .. .	90	195	450	—
Ditto, precipitated, and	220	245	450	430
gently ignited.. .. .				

Dr. GLADSTONE pointed out that the above paper was the first fruits of the Research Fund, and was therefore of special interest to the Society. He complimented the authors on opening out a new region of thought and experiment, and on the success with which they had overcome the great difficulties they had met with in obtaining substances sufficiently pure for their experiments.

Mr. VERNON HARCOURT asked if any experiments had been made as to the effect of time on the reactions: whether, for instance, given an unlimited time, a reaction would not go on to the end at a comparatively low temperature. He would also like some further explanation of the term "algebraic value of the heat disturbance."

Mr. WILLS enquired whether, after heating, cooling, and re-heating a substance several times, a rising of the initial temperature of reaction did not take place; also how it was possible to compare the action of a solid body, as carbon, with the action of gases such as hydrogen.

After some remarks by Messrs. Kingzett, Neison, and Drs. Dupré and Armstrong,

Dr. WRIGHT briefly replied to Mr. Harcourt that experiments of the kind indicated were in progress; that the above term was used simply to express the production of heat, whether it was a positive or a minus quantity, and that "heat disturbance" was simply a translation of the German word "Wärmetönung." In reply to Mr. Wills Dr. Wright said that the temperature did rise, and so care was taken always to have fresh samples for each experiment: that as regards the relative action of a solid and a gas, the solid would no doubt act very much less rapidly, but this would not affect the temperature at which the action commenced.

The next paper was communicated by Mr. C. T. KINGZETT, "On the Chemistry of Cocoa-Butter (Part I. Two New Fatty Acids)." The specimen of cocoa-butter examined was hard, imperfectly transparent, slightly yellowish, melting at about  $30^\circ \text{C.}$ , and when once melted remaining liquid for some time at a lower temperature: it contained no volatile or soluble fatty acids. The acids were prepared by saponifying the butter, and decomposing the soaps with dilute sulphuric or hydrochloric acid. They were purified by recrystallisation from alcohol, fractionating, &c. Many analyses and melting-points of products obtained are given. The extreme acids found were represented by the formulæ  $\text{C}_{12}\text{H}_{24}\text{O}_2$  and  $\text{C}_{64}\text{H}_{128}\text{O}_2$ . The first is the formula of lauric acid, but it melts at  $57.5^\circ$  (lauric acid melting at  $43^\circ \text{C.}$ ), so it must contain some acid of a higher melting-point than lauric acid, and therefore the acid itself must be lower in the series  $\text{C}_n\text{H}_{2n}\text{O}_2$  than lauric acid. The highest known acid in this series is melissic acid,  $\text{C}_{30}\text{H}_{60}\text{O}_2$ , the new acid has a formula not lower than  $\text{C}_{64}\text{H}_{128}\text{O}_2$ . Many salts of these acids were prepared, but details as to their composition are reserved for a future communication. The lower acid crystallises in pearly plates or fine long needles. The higher acid—for which the author proposes the name of "Theobromic Acid"—crystallises in microscopic needles or granules, melts at  $72.2^\circ \text{C.}$ : at a high temperature distils apparently unchanged, and is somewhat electric when dry, a property which is possessed in a high degree by its silver salt. The total fatty acids of cocoa-butter contain about 20 per cent oleic acid. The author, in conclusion, points out that textbooks state that "cocoa-butter yields, almost exclusively, stearic acid." From the present investigations it is clear that this statement is entirely incorrect. It is based entirely on determinations of the melting-point of the fatty acids obtained.

Mr. DUFFY said that from the proportion of carbon he should have expected a higher melting-point, observing that a very small quantity of a fatty acid containing a low percentage of carbon had an enormous effect on the melting-point of a high acid, perhaps from some kind of solvent action.

The next paper was read by Dr. ARMSTRONG, "On the Influence Exerted by Time and Mass in certain Reactions in which Insoluble Salts are Produced," by M. M. P. MUIR. In this paper the author has worked out in detail a suggestion given by Dr. Gladstone (*Chem. Soc. Journ.*, ix., 54) to the following effect:—"It is easily conceivable that where the affinity for each other of two substances that produce an insoluble compound is very weak the action may last some time, and become evident to our senses. Is not this actually the case when . . . carbonate of soda in solution is added to chloride of calcium?" The author has taken solutions containing known quantities of calcium chloride and potassium or sodium carbonate, and allowed them to stand for a certain number of minutes after mixing, collected the precipitate formed, and thus has obtained approximate results, which are, however, strictly comparable among themselves. These results the author has represented graphically in curves. The greater portion of the chemical change takes place during the first five minutes, afterwards the reaction decreases very much in rapidity. The relative masses of the salts exert an important influence. Thus if the mass of alka-

line carbonate be four times that required by the equation  $\text{CaCl}_2 + \text{M}_2\text{CO}_3 = 2\text{MCl} + \text{CaCO}_3$ , the action is completed in five minutes, but if the salts are mixed in equivalent quantities the action is not completed in forty-six hours. For short periods of time potassium carbonate yields more calcium carbonate than sodium carbonate. An increase of the temperature produces in every case an increase in the amount of calcium carbonate formed in a given time, whilst dilution causes a marked decrease. Dilution with sodium and potassium chloride solution gives a still more marked decrease. A discontinuous addition of one of the solution to the other causes the action to reach a maximum more quickly than when the solutions are mixed at one time, but the maximum so reached is no greater than that which is finally attained under the latter conditions. In conclusion the author gives the results obtained by mixing solutions of calcium sulphate and sodium chloride, allowing them to remain for four weeks, and then estimating the calcium sulphate decomposed. When 14.2 molecules of sodium chloride were used to 1 of calcium sulphate 32.9 per cent of the latter was decomposed. Further experiments on this subject are promised. (See Graham, *Chem. Soc. Journ.*, iii., 60). Graham has shown that sulphates of potassium and sodium are decomposed by lime-water, yielding diffusates containing caustic potash and soda respectively. The above experiments show how the chlorides of the alkalies may yield sulphates, and these in turn may furnish the alkaline carbonates required by plants.

The Society then adjourned to December 6, when the following papers will be read:—(1) "On Gallium," by Prof. Odling; (2) "On the Constitution of the Terpenes, and of Camphor," by Dr. Armstrong; (3) "On Potable Waters," by Dr. Mills.

ERRATUM.—Throughout the abstract of Mr. Perkin's paper (read Nov. 1), p. 211, for "cinnenyl" read "cumenyl."

## DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

October 15, 1877.

Professor C. LIEBERMANN, Vice-President, in the Chair.

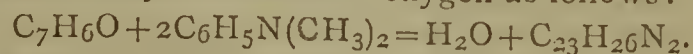
BRIEF mention of the loss to the Society through the death of its Secretary was made by the presiding officer.

The following papers were presented:—

C. LIEBERMANN and H. PLATH confirm Rosenstiehl's "Formula of Pseudo-purpurin,"  $\text{C}_{14}\text{H}_4(\text{OH})_3\cdot\text{O}_2\cdot\text{CO}_2\text{H}$ , i.e., purpurin-carbonic acid. When heated for a short time with HKO it is changed completely into purpurin.

J. H. VAN'T HOFF establishes the following law on the "Connection between Optical Activity and Constitution:—" The optical activity disappears in those derivatives of active bodies, by the formation of which the so-called asymmetry of the carbon atoms ceases. For example, the inactive succinic acid prepared from dextro-tartaric acid, and the inactive amylen and methyl-amyl derived from active amylic alcohol.

O. FISCHER, "Condensation Products of Tertiary Aromatic Bases." Treatment of meta-bromo-dimethyl-aniline with phthalic chloride gives the phthalein of the former,  $\text{C}_{24}\text{H}_{22}\text{Br}_2\text{N}_2\text{O}_2$ , a bluish compound, forming with acids reddish yellow solutions. Dimethyl-aniline forms with benzaldehyd a base from oxygen as follows:—



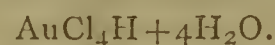
With furfurol it forms a similar base.

A. HORSTMANN, "Relative Affinity of Oxygen to Hydrogen and Carbonic Oxide." The author gives the results of his experiments on the truth of Bunsen's law, that when an insufficient amount of O is used the ratios between the volumes of the products of combustion,  $\text{H}_2\text{O}$  and  $\text{CO}_2$ , always can be expressed by small whole numbers. The

law which he establishes in its place is that—"The ratio between the volumes of the two gases produced is equal to that between the unaffected H and CO, multiplied by a coefficient of affinity which is independent of the ratio between the original combustible gases, but dependent on the relative amount of O present." Among the facts noticed are—(1) With increasing amounts of oxyhydrogen gas, and the same amount of CO, the ratio of  $\text{H}_2$  to  $\text{CO}_2$  increases gradually and not by sudden alterations. (2) The presence of  $\text{H}_2\text{O}$  vapour diminishes the amount of H burned, and CO is affected in the same way by the presence of  $\text{CO}_2$  in the mixture of gases. (3) There is always more H relatively than CO burned, so that the affinity of O for H is greater than for CO.

F. FITTICA, "The Nitro-benzaldehyd corresponding to the Fourth Nitro-benzoic Acid ( $127^\circ$ ). By pouring a mixture of benzaldehyd and ethyl-nitrate into  $\text{H}_2\text{SO}_4$  the author obtained, besides the ordinary nitro-benzaldehyd, an isomeric, a yellowish oil boiling at  $196^\circ$ ; which, when oxidised with chromic acid, yields the fourth isomeric nitro-benzoic acid lately discovered by him.

J. THOMSEN finds the "Water of Crystallisation in Auric Chloride-hydrochlorate" to be as follows:—



A. LADENBURG maintains his position with regard to the "Valence of Nitrogen," by giving a detailed account of his experiments, showing the distinct individualities of the two bodies,—



in answer to Meyer's criticisms.

H. W. VOGEL criticises "Chastaing's New Theory of the Chemical Action of Light," recently published in the *Ann. de Chem. et Phys.*, which claims that the action of the various coloured rays of the spectrum on inorganic bodies is dependent on their refrangibility, the red and yellow acting as oxidisers; the green, blue, and violet as reducing agents; while all rays induce oxidation in organic bodies. A number of experiments from Hunt, Herschel, Wollaston, and others are adduced to show the incorrectness of the theory, and to establish the law that "rays of all varieties can induce an oxidising or reducing action, according to the nature of the body by which they are absorbed."

A. MICHAEL has succeeded by the "Action of Br on Ethyl-phthalionide," in introducing for the first time halogens into the alcoholic radicals of amines. After introducing an acid radical into ethyl-amine it is easily brominated, yielding dibrom- and tribrom-ethyl-phthalionide.

A. CHRISTOMANOS describes "Lecture Experiments" for exhibiting the development of heat by the union of water and HCl or  $\text{NH}_3$ , which consist essentially in inserting into cylinders containing these gases thermometers, the bulbs of which are enclosed by moistened paper or cotton. In HCl gas the temperature mounts rapidly to  $70^\circ$ .

E. J. DRAGOMIS renders the "Determination of Temperatures" more certain and simple by using two thermometers, one of which is below the temperature to be measured, and the other heated above it. If these are dipped into a liquid, for example, the exact temperature is ascertained when they both stand at the same height.

E. HEPP describes some "Aldehyd Derivatives," in which the O of the aldehyd group is occupied by two amido groups. Methylal and benzyl-cyanide in the presence of  $\text{C}_2\text{H}_4\text{O}_2$  and  $\text{H}_2\text{SO}_4$  form methylen-diphenyl-acetamide,  $\text{CH}_2(\text{NH}\cdot\text{CO}\cdot\text{CH}_2\cdot\text{C}_6\text{H}_5)_2$ . In the same way benzyl-cyanide and chloral form trichlor-ethyliden-diphenyl-acetamide,  $\text{CCl}_3\cdot\text{CH}(\text{NH}\cdot\text{CO}\cdot\text{CH}_2\cdot\text{C}_6\text{H}_5)_2$ , and aceto-nitrile and chloral, trichlor-ethyliden-diacetamide,  $\text{CCl}_3\cdot\text{CH}(\text{NH}\cdot\text{CO}\cdot\text{CH}_3)_2$ . They all crystallise in small white needles, and are very insoluble.

The same prepares "Azophenetol" by the action of HKO and zinc-dust on nitrophenetol in alcoholic solution, obtaining quantitative results; and describes a "New Formation of Hydroquinon," which consists in the action of hydroxylamin on a solution of nitroso-phenol in  $\text{HNaO}$ .

C. COUNCLER, "Boric Ethers." Allyl-borate unites

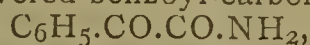
with Br to form a hexabromide  $(C_3H_5Br_2O)_3B$ , a brown viscous liquid. An isobutyl-borate,  $(C_4H_9O)_3B$ , was obtained from boric anhydride and isobutyl alcohol. Boric chloride and benzyl-alcohol yield dibenzyl,  $(C_7H_7)_2$ .

P. P. BEDSON has obtained "Three Isomeric Brom-amido-phenyl-acetic Acids,"  $C_6H_3Br.NH_2.CH_2CO_2H$ , by reducing the three nitro-derivatives of para-bromo-phenyl-acetic acid.

O. KRAFT finds that the "Salts of Terocrylic Acid" are changed into those of an isomeric acid by fusion with HKO. Several salts and ethers of diaterpenylic acid are described.

F. R. JAPP and G. SCHULTZ obtain a "Phenanthren-carbonic Acid,"  $C_{14}H_9.COOH$ , by saponification of the nitrile resulting from the distillation of ferrocyanide of potassium and potassium-phenanthren-sulphonate. It forms easily soluble salts, and is changed by oxidation into phenanthren-quinon-carbonic acid,  $C_{14}H_7O_2COOH$ .

L. CLAISEN, "Organic Acid Cyanides." The author obtains by the action of HCl on benzoyl-cyanide the amide of the newly-discovered benzoyl-carbonic acid,—



by interrupting the reaction at the instant when the cyanide is completely dissolved. It is soluble in alkalies, and is precipitated out on the addition of acids, but with its physical properties entirely changed, two different isomerides being produced, according to the acid used.

F. KESSEL, "Brominated Ethylic Ethers." By the action of Br on ethylen-oxochloride,  $(CH_3.CHCl)_2O$ , the author obtains an acto-bromo-ether,  $C_4H_2Br_8O$ , as tetrabromo-ethoor,  $C_2H_2Br_4$ , tribromo-acetic acid, and tetrabromo-ether,  $(C_2H_3Br_2)_2O$ . With iodine no results were obtained.

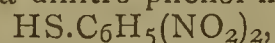
"Double Salts of Hyposulphite of Copper." The yellow salt,  $Cu_2S_2O_3.Na_2S_2O_3.CuS$ , is decomposed by the action of  $H_2O$ , yielding CuS chiefly. The white salt, obtained from the former by the action of HCl is decomposed in a similar manner.

H. KAMMERER exhibits as a "Lecture Experiment of the Direct Combustion of Nitrogen" a flask in which a magnesium ribbon is burned in air, causing the formation of  $NO_2$ , which is shown with starch.

F. GRAMP recommends for "Lecture Experiments" the combustion of zinc-turnings in a gas-flame, giving rise to an enormous dark green flame and a thick column of white  $ZnO$ ; and the boiling of cadmium in a porcelain crucible, accompanied by combustion of the vapours, which colours the flame dark red, and forms a brown cloud of  $CdO$ .

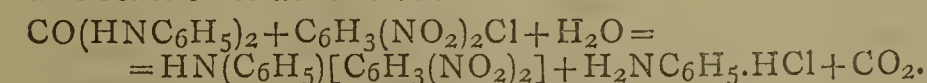
A. KASTROPH prepares "Phenetol" direct from phenol and alcohol by heating the mixture with  $ZnCl_2$  or  $P_2O_5$ .

C. WILLGERODT, "Action of  $\alpha$ -Dinitro-chloro-benzene on Sulpho-carbamide." The reaction, carried on in a closed tube at  $150^\circ$ , yields  $\alpha$ -dinitro-phenol-mercaptan,—

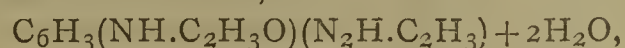


crystallising in yellow needles. The author finds that the reactions of  $\alpha$ -dinitro-chloro-benzene with acid amides are only possible under pressure, and are furthered by the presence of  $H_2O$ , alcohol, and magnesia. The chief product is always an amine.

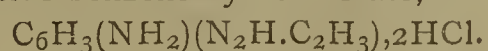
"Action of  $\alpha$ -Dinitro-chloro-benzene on Carbanilide." The reaction is as follows:—



H. SALKOWSKI, "Anhydro Bases Derived from Triamido-Benzene." By treatment with acetic anhydride an acetyl-ethenyl-triamido-benzene,—



is obtained, which by the action of HCl is changed into ethenyl-triamido-benzene-hydrochlorate,—



The acetyl derivative of chrysanisic acid,—



is formed by heating it with acetic anhydride.

H. HÜBNER communicates the following researches which have been carried out in connection with students in the Göttingen laboratory:—

"Salicylic Acid and  $HNO_3$ ." The two isomeric acids,  $C_6H_3.NO_2.OH.COOH$ , resulting from the nitration of salicylic acid, have been changed into the corresponding amido-nitro-benzoic acids and nitro-benzoic acids, from which it appears that in one the position is—



and in the other  $OH.COOH.NO_2, 1.2.4$ . They both yield the same dinitro-salicylic acid—



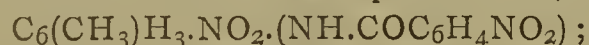
Sulphonic acids have been obtained from some of the nitro and amido derivatives.

"Dinitro-benzoic Acid and Nitramido-benzoic Acid." The acid,  $C_6H_3.COOH(NO_2)_2$ , obtained in large quantities from the action of  $HNO_3$  on benzoic acid, was reduced to nitro-amido-benzoic acid, and in this, on the one hand, H substituted for  $NH_2$  (forming meta-nitro-benzoic acid), and, on the other hand, Cl substituted for  $NH_2$  and  $NO_2$  eliminated, yielding meta-chloro-benzoic acid; thus showing that both  $NO_2$  groups in the dinitro acid occupy the meta position, and that negative groups on entering benzoic acid usually take the meta position to the  $COOH$  group. A number of salts and ethers of the two acids are described.

"Brominated Benzoic Acids." These include two dibromo-benzoic acids obtained from the isomeric meta-bromo-ortho-nitro-benzoic acids, three tribromo-benzoic acids, three dibromo-salicylic acids, para-meta-bromonitro-benzoic acid,  $C_6H_2.Br_2.NO_2.COOH$ , and the corresponding amido-acid, para-bromo-metamido-benzoic acid, brom-nitro-salicylic acid, and a number of derivatives.

"Nitro-benzanilides and  $HNO_3$ ." The ortho- and para-compounds yield the same trinitro-benzanilide,  $C_6H_3.NO_2.NO_2.NH(CO.C_6H_4.NO_2)$ , while the meta forms three other isomeric compounds. Mono- and dibromoderivatives of these nitranilides are also described.

"Anhydro Bases." The nitro derivatives of the  $\alpha$ - and  $\beta$ -benzoyl-xylidins yield on reduction anhydro-diamidobenzoyl-xylens,  $C_6H_2.(CH_3)_2.N_2H...C.C_6H_5$ . Meta-nitrobenzmesidin,  $C_6(CH_3)_3H_2.(NH.COC_6H_4.NO_2)$ , yields with  $HNO_3$  a mono and dinitro compound. Other bases described are nitro-meta-nitro-benz-para-toluide,—



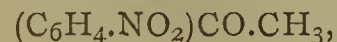
anhydro-toluyldiamido-benzene,—



the corresponding diamido-toluen, and diamido-xylene. Nitro derivatives of succin-naphthyl,  $C_{10}H_7N(COC_2H_4CO)$ , have also been obtained.

"Ortho-nitro-benzo-nitril" has been formed from the nitro-benzamide, and reduced to the corresponding amido-benzo-nitrile,  $C_6H_4.NH_2.CN$ .

"Acetophenon" forms on nitration—



which gives rise to an amido compound, and forms meta-nitrobenzoic acid by reduction.

"Replacement of Diazo Groups by the Group  $SO_3H$ ." This is accomplished by submitting the compounds to the action of sulphurous acid in alcoholic solutions. Meta- and para-diazo-imido-benzoic acids are thus changed into the corresponding meta- and para-sulphi-benzoic acids,  $C_6H_4(COOH)(SO_3H)$ .

"Iodine Cyanide and Amides." The best method of preparing and separating the three isomeric nitranilins from each other is detailed. By treatment with  $CNI$  they give rise to carbo-nitro-tetra-imido-benzenes,—



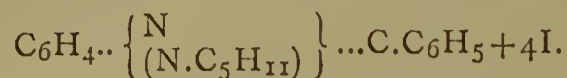
in which the  $NO_2$  can be reduced to an amido-compound, and this in turn with  $HNO_2$  changed into a nitroso-azo-oxy-hydroxyl derivative,—



"Action of Amylic Iodide and Iodine on Anhydro-Benzoyl-diamido-benzene."  $C_5H_{11}I$  alone causes the formation of a dark red insoluble compound,—



Accompanied by iodine, it yields a black crystalline body,



An ethylic derivative corresponding to the first-mentioned has been obtained.

P. T. CLEVE, "Sulpho Derivatives of Naphthalen."  $\alpha$ -nitro-naphthalen-sulphonic acid is obtained by the action of  $H_2SO_4$  on nitro naphthalen, and by treating the  $\alpha$ -sulphonic acid with  $HNO_3$ , and changed by reduction into an amido-acid, which yields with  $HNO_2$  the  $\alpha$ -diazo-naphthalen-sulphonic acid,  $C_{10}H_6(N_2)(SO_3)$ , and with  $H_2O$ ,  $\alpha$ -dioxyl-naphthalen,  $C_{10}H_6(OH)_2$ . The  $\beta$ -nitro-sulphonic acid is derived directly from the  $\beta$ -sulphonic acid. The sulpho-naphthalide  $(C_{10}H_7)_2SO_2$ , formed as a by-product by the action of  $H_2SO_4$  on  $C_{10}H_8$ , has been examined, and changed with  $PCl_5$  into the  $\beta$ -sulphon-chloride and  $\beta$ -chlor-naphthalen. The naphthionic acid, prepared from naphthylin with  $H_2SO_4$ , gave with  $HNO_2$  the diazo-acid,  $C_{10}H_6(N_2)(SO_3)$ , and with  $PCl_5$  a dichloro-naphthalen. Two other dichloro-naphthalens were formed by distillation of the two sulphonic acids with  $PCl_5$ .

O. WICHMAN describes all of the "Chloro-derivatives of Naphthalen" now known, to the number of which he has added some new bodies. The list includes, among the substituted derivatives,  $C_{10}H_7Cl$  (2 isomerides);  $C_{10}H_6Cl_2$  (7 isomerides);  $C_{10}H_5Cl_3$  (4);  $C_{10}H_4Cl_4$  (4);  $C_{10}H_3Cl_5$  (1); and  $C_{10}Cl_8$  (1). Among the additive products are  $C_{10}H_8.Cl_2$  (1);  $C_{10}H_8.Cl_4$  (1);  $C_{10}H_7Cl.Cl_4$  (2);  $C_{10}H_6Cl_2.Cl_4$  (3); and  $C_{10}H_5Cl_3.Cl_2$  (2).

J. A. CARLSON has prepared several "Amido-derivatives of Naphthalen-sulphonic Acid," such as— $C_{10}H_7.SO_2.NHC_6H_5$ , by the action of aniline, ethylamine, and naphthylamine, on the sulphon chloride.

A. G. EKSTRAND, "Sulphonic Acids of Retene." By the action of  $H_2SO_4$  at ordinary temperatures the disulphonic acid,  $C_{18}H_{16}(SO_3H)_2$ , results, while the trisulphonic acid is produced at  $100^\circ$ .

C. G. LINDBOM, "Cyanides of Gold." A large number of various salts with the metals are described, such as  $KCy.CyAu$ ,  $KCy.CyAuCy_2$ ,  $KCy.CyAuI_2$ ,  $NaCy.CyAuBr$ , &c.

N. ENGSTRÖM gives the "Analyses of Several Rare Minerals," such as orthite, vasite, endmannite, tritonite, and orchenite.

## NOTICES OF BOOKS.

*Shorthand for General Use.* By J. D. EVERETT, M.A., D.C.L., Professor of Natural History in the Queen's College, Belfast. London: Marcus Ward and Co. 1877.

SUCH an immense quantity of work has to be gone through now-a-days in so short a time that any effort to reduce labour must be looked upon as a boon. Possibly the readers of the CHEMICAL NEWS for 1877 will have learned shorthand at school, where it ought to be taught, and will be able to write the word "though" with two movements of the pen instead of with about twenty, as is the case in the present year of grace. Prof. Everett's little manual, although somewhat beyond our ken, seems to be an excellent one. His method is partially phonetic, like Pitman's: he also uses thick and thin strokes for the hard and soft consonants. The great difference, however, between this system and all others is the substitution of characters for the vowels instead of diacritical marks; in fact, to speak philologically, Prof. Everett's is an Aryan system, where each letter has its distinct character, whereas all others are Semitic systems, in which the vowels are either left

out or indicated by diacritical points. To an outsider this appears a manifest improvement, although practised shorthand writers decry it as a heresy, possibly for the same reason that they condemn every other system but their own—because it is not their own. The proof of the pudding, however, is in the eating, and the Professor tells us at the annual examination of the Belfast Phonetic Shorthand Writers' Society he was awarded a certificate for a hundred and sixty words a minute—a speed exceeding by ten words a minute that of the fastest of his competitors.

Judging from an outsider's point of view, we should be inclined to recommend this little work to all would-be phonographers.

*Harvard University: Bulletin of the Bussey Institution.* Vol. ii., Part 2, 1877.

THIS issue is chiefly devoted to inquiries into the dietetic value of certain vegetables, such as pumpkins, vegetable marrows, blue-joint grass, Canary reed-grass, the dandelion, and the nettle. Neither the writers nor the European authorities quoted seem at all aware to what an extent the last-named plant is eaten as a spring-vegetable in some parts of the north of England.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 19, November 5, 1877.

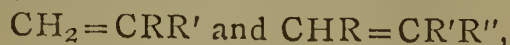
**Hydrogenation of Benzine and of Aromatic Compounds.**—M. Berthelot.—The author has pointed out ten years ago a general method for saturating organic compounds with hydrogen, consisting in the use of an aqueous solution of hydriodic acid saturated in the cold, and employed in large excess and for a considerable time at a temperature of from  $275^\circ$  to  $280^\circ$ . This method applied to the compounds of the aromatic series as well as to those of the fatty series furnishes the successive terms of hydrogenisation up to the extreme limit of the formenic or saturated carbides, more difficult to attain with the compounds of the aromatic series. Thus benzol, the fundamental pivot of the aromatic series, has been transformed into a saturated carbide, volatile at  $69^\circ$ , the composition and properties of which are the same as those of the hexylen hydride obtained by MM. Pelouze and Cahours from American petroleum.

**Liquefaction of Acetylen.**—M. Cailletet.—When acetylen is compressed, its initial temperature being  $+18^\circ$  at the pressure of 83 atmospheres, numerous drops are formed and flow along the inner sides of the tube. If the pressure is reduced some atmospheres the liquid is suddenly resolved into gas, and the tube is for a moment filled with a dense mist. Liquid acetylen is colourless and very mobile; it seems to refract light strongly; it is much lighter than water, in which it dissolves to a large extent. It dissolves paraffin and fatty matters. If liquid acetylen is cooled to zero in presence of water and linseed oil, there is formed a white, snow-like solid, which is again destroyed if gently heated, or if the pressure is reduced, with the evolution of numerous bubbles of gas. Acetylen is liquefied at the following pressures:—

At $+1^\circ$ .. ..	48 atmospheres.
2.5° .. ..	50 "
10° .. ..	63 "
18° .. ..	83 "
25° .. ..	94 "
31° .. ..	103 "

Hydride of ethylen at  $+4^\circ$  is liquefied at 46 atmospheres.

**Action of Hydrochloric Acid upon Two Isomeric Butylenes and upon the Olefines in General.**—J. A. Le Bel.—The ethylenic carbides, whose structure may be represented by the formulæ—



combine with cold hydrochloric acid. On the other hand, the hydrocarbides  $\text{CH}_2=\text{CHR}$ , and probably those represented by the formula  $\text{CHR}=\text{CHR}'$  are not attacked.

**Alteration of Eggs Induced by Mould Derived from without.**—A. Béchamp and G. Eustache.—Hen's eggs may be preserved for a long time in a medium abounding in infusoria without these being able to traverse the shell and penetrate into the interior. But microscopic moulds can penetrate both the shell and its lining, and develop themselves in abundance on its internal surface.

*Biedermann's Central-Blatt für Agrikultur Chemie,*  
Heft 6, June, 1877.

**The Summer Rain-Periods of Germany.**—G. Heltmann.—There occurs in Germany a double maximum, both in the quantity and the frequency of rain for the summer months. The first maximum, as regards quantity, falls in the beginning of the second half of June; as regards quantity, in the beginning of July. The second maximum for both is in the middle of August.

**Researches on the Action of Water containing Carbonic Acid upon certain Minerals and Rocks.**—Dr. J. Müller.—The minerals and rocks examined were adular from St. Gothard, oligoklas from Ytterby, hornblende rock from Altenburg, magnetic iron ores from the Zitterthal and from the Kaschberg in Bohemia, merosite from Hammond, in St. Lawrence County; apatite from Katharinenburg; asparagite from Chili; olivesic rock from the Ultenthal, in Tyrol; noble serpentine from Snarum. All these rocks and minerals were decomposed by water containing carbonic acid. Lime, potassa, soda, and the protoxides of iron, manganese, nickel, and cobalt were converted into carbonates. When alkaliferous silicates, such as adular and oligoklas, were acted on, small quantities of silicic acid were dissolved, probably as hydrate. Even alumina was dissolved in a minute quantity. The reddening of felspar is the first stage of decomposition, and the formation of kaolin the second. Augmented pressure promotes the action of carbonic acid water more than increased time. The behaviour of magnetic iron ore with hydrochloric acid throws no light on its decomposibility by carbonic acid water. Apatite dissolves much more readily in such water than might be expected from its appearance under the microscope.

**Researches on the Capillary Conduction of Water in the Soil, and on its Capillary Saturability with Water.**—Dr. von Klenze.—An important treatise, to which it would be impossible to do justice in the space at our disposal.

**Nature of the Peruvian Guano now imported into Belgium.**—Prof. A. Petermann.—The percentage of nitrogen in guano is found to be continually sinking, and ranges at present from 2 to 9.

**Contamination of the Air by Cesspools, and on the Efficacy of the Ordinary Disinfectants.**—Dr. F. Erismann.—Eighteen cubic metres of excrement as found in cesspools gives off in twenty-four hours 11.144 kilos. of carbonic acid, 2.040 of ammonia, 0.033 sulphuretted hydrogen, and 7.464 carburetted hydrogen, forming a total of 20.681 kilos., or, in round numbers, 18.79 cubic metres of irrespirable gases! The author considers copperas, and especially sulphuric acid, as the best disinfectants.

**Means for Preventing Putrefaction and Destroying Stenches.**—A. Eckstein.—The author considers chloride of lime the most powerful agent for deodorising privies. He proposes to use it wrapped up in parchment-paper to

prolong its action. He found that the aqueous solution of 1 kilo. of copperas destroyed the odour of  $\text{H}_2\text{S}$  in a privy used daily by at least 100 persons. After twelve hours the action was at end. The action of sulphate of copper was similar. 1 kilo. of solid copperas acted for two days. 1 kilo. of a mixture of copperas and sulphate of copper with carbonate of lime acted for two days. Liquid sulphurous acid acted very rapidly: for one hour it was oppressive to breathe, and its action had disappeared after twenty-three hours. Crude carbolic acid added to the extent of 30 grms. diffused so unpleasant a smell for two days that its local action could not be observed. 1 kilo. of copperas in a bag of parchment-paper only began to act in two hours, and kept the place inodorous for three days. 1 kilo. of good chloride of lime in a similar bag acted perfectly for nine days. 60 grms. permanganate of soda acted immediately, but its effect ceased in twenty-four hours. If enclosed in parchment-paper it was efficacious for two days. Chloride of lime along with sulphuric acid is pronounced the most powerful disinfectant (deodoriser?) known.

*Moniteur Scientifique Quesneville.*  
November, 1877.

**Report on the Exhibition of Dyed and Printed Goods, and of Chemical Products held on Occasion of the Fiftieth Anniversary of the Industrial Society of Mulhouse.**—M. Theodore Schneider.—MM. Kopp and Goppelsröder, professors at the Chemical School, exhibited the results of the spectrum-analysis of a great number of colours and of dyed and printed tissues. The results are given in a series of 200 drawings. Among the dyes examined are murexide, magenta, azalein (?), eosin, yellow and red corallin, picric acid, dinitro-naphthalin, Lyon blue, cyanin, diphenylamin blue, green, blue, and violet ultramarines, aniline-blacks, aldehyd and methyl greens, Hofmann's, Poirier's, and Perkin's violets, &c. For plastic, opaque, or insoluble colours like ultramarines, aniline-blacks, &c., the analysis has been limited to the examination of the projection-spectrum obtained by placing a very fine glazed paper, previously covered with a uniform layer of colouring matter, in the many-coloured bundle of rays emerging from a flint glass prism. As for the colours soluble in water, alcohol, or any other medium, they have been examined directly with the spectroscope. Beginning with solutions containing 1 part in 1000 the authors carried on the dilution in geometrical progression until the normal spectrum was reached, i.e., until the influence of the dye upon the spectrum became imperceptible. 1 grm. of colouring matter was thus successively dissolved in 1, 2, 4, 8, . . . 64 litres of solvent. The authors purpose to continue the researches on this subject, and to examine in succession if one and the same colouring matter prepared by different methods, or produced directly upon the tissue, presents the same spectrum; what may be the influence of the homologue, and the isomerism of the organic radicals introduced into dyes as regards shade and tinctorial power; what is the influence of the basicity of the acids combined with coloured bases and that of the acidity and the nature of the bases combined with coloured acids. They will compare colours applied in the dry state, and without any mixture upon glazed paper with the same colours fixed by dyeing or printing according to different methods in use. Lastly, they will determine the influence of the different thickeners, as well as that of steaming and brightening. It is hoped that these researches will not only lead to a method for the rapid detection of different colouring-matters similar in shade, but that they will furnish easy and expeditious processes for determining the commercial value of certain colouring-matters, such as indigo.

**Analysis of Indigo.**—V. Tantin.—The author points out the inaccuracy of all the volumetric processes depending upon the action of an oxidising agent upon

indigotin, inasmuch as gluten, indigo-brown, and indigo-red enter also into the reaction. The method of Houton Labillardière he considers in itself exact, but the colorimeter of this chemist is not trustworthy within 10 per cent. In its place he recommends an improved colorimeter by J. Salleron, which he figures and describes, and which enables very slight differences in the intensity of two shades of colour to be distinctly recognised. His method of operation is as follows:—

1. *Taking the Specimen.*—About 5 grms. are scraped with a knife from the merchants' sample. If the latter is composed of several pieces a quantity is scraped off each, proportionate to its weight.

2. *Pulverisation and Sifting.*—The 5 grms. of indigo taken for analysis are ground in an iron mortar and passed through a sieve of silk having 100 meshes to the square centimetre. The pulverisation and sifting should be continued till nothing remains, for if the harder fragments less easily ground are rejected, the process cannot show the real value of the indigo.

3. *Weighing.*—0.30 gm. of each indigo under examination is then weighed out in a balance sensitive to  $\frac{1}{2}$  milligram.

4. *Selection of a Standard.*—We take *pure indigotin*, which may be obtained by collecting the scum which forms constantly upon the surface of the indigo vats, and treating it with hydrochloric acid diluted with water in order to remove all foreign matter. The residue from this operation, very carefully washed upon a filter and dried, is preserved in bottles with ground-glass stoppers. The comparison of the samples with this standard demands much attention. It should be used merely to determine the value of some indigo which may in turn serve as a standard for other samples.

5. *Solution of the Indigos in Sulphuric Acid.*—The 0.30 gm. of each sample and of the standard is introduced into flasks of a peculiar form, known as assay-flasks. To each must be added 10 grms. of pounded glass previously washed and perfectly dried, and into each flask is poured by means of a pipette 5 c.c. of sulphuric acid chemically pure. The author attaches great importance to the use of this acid in preference to that of Nordhausen, which gives purple solutions in which the eye with difficulty recognises slight variations of intensity. The flasks are heated in a water-bath to a temperature of 60° to 70°, taking care to agitate every half-hour. After the lapse of four hours, the solution of the indigotin being complete, the product in each case is diluted with water and made up to 3 litres. For the sake of exactness this dilution is carried on in a narrow-necked flask which holds 3 litres up to a mark on the neck. The liquid is then allowed to settle for half an hour before transferring it into the colorimeter.

6. *Comparison of the Intensity of the Solutions in the Colorimeter.*—10 c.c. of the solution under examination are poured into the right-hand tube of the colorimeter, and the same measure of the standard solution into the left-hand tube. The latter will ordinarily be the deeper (invariably if pure indigotin is taken for a standard). By means of the burette attached to the instrument a few drops of water are poured into the left-hand tube, and by means of the caoutchouc tube air is gently blown in, so as to mix thoroughly the coloured solution and the water added. If the two liquids have not yet exactly the same shade more water is added by small portions, blowing in air each time till perfect equality is reached. The number of c.c. of water used is then read off, and the value of the indigo under examination will be inversely as the figures obtained. To have results absolutely exact we ought to compare only indigos from the same locality, for it is very evident that for equal percentages of indigotin a Bengal indigo should have a superior value to one from Java or Guatemala.

**The Latest Researches on Aniline-Black.**—A summary of recent improvements in the production of aniline-blacks, which have been already laid before our readers.

**Determination of Phosphorus in Iron Ores.**—Carl Holtoff.—The author's object is to ascertain the causes to which are due the differences in the proportion of phosphorus contained in iron ores, and he reviews the methods in use for its determination. One of them consists in disaggregating the ore with carbonate of soda and a little silica. This method he puts aside as inconvenient. He examines that which depends on the precipitation of the phosphoric acid as basic ferric phosphate in a feebly acetic and boiling solution, dissolving then in hydrochloric acid the precipitated phosphate and the basic ferric acetate, adding citric acid to the solution, saturating with ammonia, and precipitating the phosphoric acid with magnesia mixture. The result is always too small. It is necessary to re-dissolve in hydrochloric acid the last precipitate, which always retains some iron, and to recommence the rest of the operations, renewing the cause of loss, which depends on the solubility of the ammonio-phosphate of magnesia in citrate of ammonia. Do we sometimes omit to keep the solution of ferrous acetate at a proper temperature? Does the ferric acetate formed under these circumstances dissolve the precipitate of ferric phosphate? Or is this last precipitate itself soluble in ferrous acetate? Without attempting to solve these questions the author examines the method, which consists in precipitating the phosphorus by the molybdic solution, dissolving the precipitate of ammoniaco-molybdic phosphate in ammonia, partially neutralising the ammonia with hydrochloric acid, and precipitating the phosphoric acid by the magnesian mixture. The results, according to the author, have always been very satisfactory. They agree equally when the solvent has been hydrochloric acid, provided that the molybdic solution is in large excess, *i.e.*, at least 60 c.c. of solution for each centigram of phosphoric acid in solution, provided that the free hydrochloric acid does not exceed 2 per cent, that the whole is allowed to stand a sufficient time for the precipitate to settle, and that the whole is not raised above blood-heat. Comparative experiments made with the same quantities of liquid have not given notable differences when the hydrochloric acid had been eliminated and replaced by nitric acid by means of evaporation in the water-bath, and the addition of strong nitric acid. In this case, however, the separation of the precipitate is much more rapid, and is further accelerated by heating. The determination may, then, be effected even in hydrochloric solutions, but it is an important condition of success not to heat the liquid strongly. If the hydrochloric solution of iron, mixed with nitric acid and molybdate of ammonia, is heated, the nitric and hydrochloric acids decompose each other respectively, the solvent of the molybdic acid disappears, and this acid is separated. The phospho-molybdate of ammonia at first precipitated becomes soluble again in the supernatant liquid, and which is almost free from molybdic acid. Apparently the chlorated compounds set free decompose the ammonia in the double salt; this is destroyed and the phosphoric acid becomes soluble again. This is the cause that in liquids filtered from the above solutions after being strongly heated, and which have always a distinct odour of chlorine, we may always detect and determine very considerable quantities of phosphoric acid by further additions of molybdic acid. In many laboratories it is customary when using this method to heat to 60° and upwards the hydrochloric solution of the substance under analysis, after the addition of the molybdic mixture. Here, without doubt, lies the cause of the discrepancies complained of. There is a further cause of error in the execution of this method. The precipitate formed by magnesia mixture in the solution of the phospho-molybdate of ammonium in dilute ammonia, after being almost neutralised with hydrochloric acid, has been to this day regarded as pure ammonio-magnesian phosphate. The author has been in the habit of re-dissolving this precipitate in hydrochloric acid and re-precipitating with ammonia, and on examining the filtrates has always been able to obtain from them considerable precipitates by

treatment with phosphoric acid or hydrogen phosphide. He has certainly prepared the magnesian mixture with magnesium sulphate. But he has found by repeated trials that even the reagent prepared with magnesium chloride gave precipitates which, if weighed, dissolved in hydrochloric acid, and re-precipitated by ammonia in large excess, so that the liquid may contain at least 3 per cent of free ammoniacal gas, showed losses of weight inexplicable by facts hitherto known. The filtrates contained magnesia as well as molybdic acid, and so much the more as the original precipitate was more flocculent. He has often found that the precipitates thus obtained after two precipitations contained molybdenum, although he has not been able to find the cause of this fact. To be certain that we have nothing but pure ammonio-phosphate of magnesia and to be able without doubt to assume 27.93 per cent of phosphorus in the calcined precipitate, he prefers to dissolve in as little hydrochloric acid as possible the first precipitates obtained; to evaporate the solution to dryness, in order to separate the small quantities of silicic acid present; to re-dissolve in a few drops of silicic acid and hot water; to treat with sulphuretted hydrogen so as to throw down all the molybdenum; then after filtration and concentration to precipitate with ammonia and after standing for twelve hours in a cool place in a well-covered beaker, to filter, and thus to conclude the process.

*Les Mondes, Revue Hebdomadaire des Sciences,*  
No. 8, October 25th, 1877.

This issue contains no original chemical matter.

No. 9, November 1, 1877.

This issue contains no chemical matter.

*Bulletin de la Société d'Encouragement pour l'Industrie Nationale.*

No. 47, November, 1877.

Report Presented by M. Salvétat on Behalf of the Committee of the Chemical Arts on the Coloured Muslin Glass of M. Aubriot.—After having enumerated the methods now in use for rendering glass less transparent, the author describes M. Aubriot's process, which consists substantially in applying to the surface of the glass a vitrifiable colour mixed with gum-water, drying, steaming, and heating in the muffle. Patterns of any kind can be easily produced.

Report Presented by M. Salvétat on Behalf of the Committee of the Chemical Arts on the Works of Appert Brothers, Manufacturers of Enamels, Glasses, Crystals, and Vitrifiable Colours.—The nature of this paper appears sufficiently from the title.

Report Presented by M. Schützenberger on Behalf of the Committee of the Chemical Arts on the Mechanical Manufacture of Paper Filters Invented by MM. Laurent.—The inventors have constructed a machine for folding sheets of paper automatically, and converting them into filters ready for use.

*Reimann's Färber Zeitung,*  
No. 41, 1877.

In an article on the valuation of dye-wares the editor objects to colorimetric methods that they are untrustworthy when the samples to be compared have not exactly the same tone, e.g., when a greenish indigo is compared with pure indigotin which has a reddish cast. Further impure dyes, such as a tarry magenta, appear relatively darker than pure samples containing the same proportion of colour. Spectroscopic methods are objected to as too complex, requiring costly apparatus and as being applicable to substantive colours only. The portion of colour

which adheres to the sides of the tube impoverishes the solution to an extent very serious where such small quantities also are employed.

## MISCELLANEOUS.

University of London.—The following is a list of the candidates who have passed the recent Second B.Sc. Examination:—(Old regulations) *First Division*.—A. Cutfield, Epsom College, and Christ's College, Cambridge; B. A. De Watteville, M.A., University College; J. V. Elsdon, private study; W. Hudson, private study; H. F. Morley, M.A., University College; J. M. Raby, B.A., private study; W. J. Spratling, University College and private study. *Second Division*.—D. E. Anderson, B.A., University College; J. K. Bond, B.A., private study; W. Brown, private study; R. H. Cotton, B.A., Owens College; A. C. Dixon, private study; W. Fream, Royal College of Science, Dublin; G. A. Freeman, St. John's, Bathersea, and private study; T. S. Humpidge, University of Heidelberg; D. Ross, B.A., private study; A. Simpson, B.A., F. C. Divinity Hall, Aberdeen; L. C. Wooldridge, First M.B., Guy's Hospital. (New regulations) *First Division*.—A. Black, private study; G. C. Frames, Christ's College, Cambridge; W. H. Higgin, Owens College; R. H. Jude, Christ's College, Cambridge; T. Lattimer, St. John's College, Cambridge; D. McAlister, St. John's College, Cambridge; R. C. Rowe, M.A., Trinity College, Cambridge; W. L. Wills, Owens College. *Second Division*.—A. Atmaram, University College; E. H. Cook, Royal College of Science, Dublin; J. W. Evans, University College; J. L. McKenzie, private study; J. H. Paul, private study; H. Robson, private study; J. Shirley, private study; R. H. S. Spicer, St. Mary's Hospital.

The American Association for the Advancement of Science.—The meeting of this Association for 1878 will be held in August at St. Louis, Missouri. The following is a list of the general officers elected for that meeting:—President, O. C. Marsh, of New Haven; Vice-President, Section A., R. H. Thurston, of Hoboken; Vice-President, Section B., A. R. Grote of Buffalo; Chairman of Permanent Subsection of Chemistry, F. W. Clark, of Cincinnati; Chairman of Permanent Subsection of Microscopy, G. S. Blackie, of Nashville; Permanent Secretary, F. W. Putnam, of Cambridge; General Secretary, H. Carrington Bolton, of Hartford; Secretary of Section A., F. E. Nipher, of St. Louis; Secretary of Section B., George Little, of Atlanta; Treasurer, W. S. Vaux, of Philadelphia.

Russian Scientific News.—In this correspondence I will give some news regarding the recent progress of mining explorations in Russia. In the Society of Naturalists M. Pechatkin made a report on the occurrence of very rich iron ores in the Berdiansky district of the Tavis Government. Beds of magnetic iron ore, situated in the vicinity of the mountain Corsak, have the following dimensions:—700 feet long and 210 feet in breadth; the thickness of this layer is 70 feet. Near this place several other beds of magnetic iron ore of different size were examined. This ore contains 70 per cent of iron, and no sulphur or phosphorus. Near these rich iron mines brown hematite was also found in notable quantities, containing about 65 per cent of iron. The railway which is to be constructed in this district will pass near the mountain Corsak. I mentioned in my last communication about some so-called anthracite found in the Olonetz Government. It must be remarked that this mineral is not anthracite, but is a carbonaceous claystone, which gives on being ignited 32 to 40 per cent of ash containing many impurities mechanically mixed with the mineral and a sufficient quantity of sulphur to make it useless. The explorers propose to use this strange coal for boilers and metallurgical operations, and they go even so far as to maintain that this coal may be an important adjunct for foreign coals now in use in St. Petersburg. Of course

that is nothing more than words, because a fuel containing more ash than carbon, and which does not coke, has no future in metallurgy. The trial on board of a steamer showed also the total unfitness of this coal. A steamer going from St. Petersburg on fair coal reaches Cronstadt in one hour and a half: the same steamer using Olonetz anthracite reached Cronstadt in three hours' time. This fact wants no illustrations. If the Olonetz carbonaceous claystone is of no use whatever the same cannot be said about the beautiful beds of red hematite, mixed with a considerable quantity of magnetic iron ore. They are situated in the Olonetz district in the Vedlozersky parish, between the rivers Collaga, Sona, and Narvaju, about 35 miles from the Ladoga Lake. The veins of the iron ore pass through layers of reddish dolomite. The thickness of these veins is from  $3\frac{1}{2}$  to 18 feet. These rich iron ores astonish the explorers, as remarked M. Zemlinitzin, the Government engineer to this district. The calculations of this engineer show that the total quantity of iron ore only on the surface is not less than one million tons. The ore contains 59 to 75 per cent of metallic iron, and no sulphur. In St. Petersburg the pig-iron from these ores may be sold at 125 shillings the ton. In the vicinity there is a good quantity of cheap wood; labour is also cheap. Future iron works may compete very easily with the pig-iron brought from the Oural Mountains, which now may be had not cheaper than 185 shillings per ton in St. Petersburg. In the Eastern Siberia, from July 1, 1876, up to July 1, 1877, 15.26 tons of gold and 1.58 tons of silver were mined. The quantity of silver extracted is annually decreasing as the old mines are at present nearly exhausted. A careful exploration of Siberia is very desirable, because silver ores are very abundant in this country, as shown by several preliminary explorations.

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## NOTES AND QUERIES.

**Lubricating Oils, &c.**—Can any of your readers tell me where I can get the best information relative to rosin greases and the proper mixing of oils for lubricating purposes? I would also like to ask at what temperature and in what proportions will tallow, palm oil, and rosin amalgamate with a soda-lye, and what strength and at what temperature should be the lye (according to Twaddle)?—INQUIRER.

**Arsenic in Sulphur, &c.**—Will anyone inform me of a method of estimating the small percentage of arsenic in sulphur recovered by Mond's process, or in sulphuric acid made from pyrites? Mr. H. A. Smith, in his work on sulphuric acid manufacture, gives the quantities of arsenic found in pyrites acid and the secondary products, HCl,  $\text{SO}_4\text{Na}_2$ , &c., but omits the process which he used.—T. W.

## TO CORRESPONDENTS.

J. Cope.—Faraday's or Williams's "Chemical Manipulation."

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# THE CHEMICAL NEWS.

VOL. XXXVI. No. 940.

## VARIEGATED LEAVES.

By A. H. CHURCH, M.A.,  
Royal Agricultural College, Cirencester.

THE question of "albication," "albinism," or the white variegation of leaves, does not appear to have been yet approached from the chemical side. In studying the composition, modes of occurrence, and physiological position of the common colouring-matters of plants, I have been working at albication, in the hope of acquiring information concerning chlorophyll. My results so far seem to open up a new path of inquiry. The experiments were begun too late in the year, and under the serious disadvantage, from which much of my phyto-chemical work here suffers, of the absence of a greenhouse. Still, I have obtained some striking results, which if confirmed by further analyses, and supported by the very obvious synthetical experiments which they suggest, may throw much light, and must throw some, upon the nature and production of chlorophyll.

The experiments, of which I now propose to give an abstract, were performed with three plants having their green leaves variegated with white patches, or else bearing both white and green leaves. The plants were—1, *Acer Negundo*; 2, *Hedera helix*; 3, *Ilex aquifolium*. The microscopic appearances were not neglected, but are purposely not alluded to here. I shall designate the plants simply as maple, ivy, and holly, respectively, in this communication.

The maple leaves were from trees in the Agricultural College Botanic Garden, and were gathered on Sept. 17. The holly was obtained from Messrs. Jefferies's nurseries on Sept. 24. For the ivy I am indebted to Mr. Taylor, of Cirencester, a number of plants being laid under contribution, the date of collection being October 4. In every case I gathered the leaves myself, and without the intervention of knife or scissors. Weighed bottles received the specimens, so that no moisture could be lost during transit to the laboratory. It is scarcely necessary to say that every precaution was taken to gather only such leaves as could fitly be compared in age and condition of growth. The water, the combustible or volatile matter, and the ash were first of all determined. The results, translated into percentages, are here arranged in a tabular form:—

	Maple.		Holly.		Ivy.	
	White.	Green.	White.	Green.	White.	Green.
Water .. ..	82.83	72.70	74.14	62.83	78.88	66.13
Organic matter	15.15	24.22	23.66	35.41	18.74	31.63
Ash.. ..	2.02	3.08	2.20	2.47	2.38	2.24

The watery character of the white leaves, and their comparative poverty in combustible, or so-called "organic," constituents, is very marked. It may be said, speaking broadly, that the fresh green leaves of all three plants contained one-third more solid matter than the white leaves. The mineral matter or ash, when not absolutely more abundant in the white leaves, forms a larger part of their dry matter.

The nitrogen in both ivy and holly was found more abundant in the dry matter of the white leaves than in that of the green; but the percentages of nitrogen found in the fresh leaves of the two plants were such as to render further analyses necessary.

The matters soluble in ether were estimated in the dried leaves of holly and ivy. Of these matters, including wax or fat, resin, chlorophyll, and several other organic com-

pounds, fresh white ivy leaves contained 1.29 per cent, the green giving 3.27 per cent. Similarly, white holly leaves contained 1.75 per cent, and green holly 2.54 per cent.

But the most remarkable differences in composition between white and green leaves were noticed on submitting the ashes of the several plants to quantitative analysis. The nature of the results may best be seen by the following table:—

### Percentage Composition of Ash.

	Maple.		Holly.		Ivy.	
	White.	Green.	White.	Green.	White.	Green.
Potash .. ..	45.05	12.61	35.30	16.22	47.20	17.91
Lime .. ..	10.89	39.93	21.50	34.43	12.92	48.55
Magnesia ..	3.95	4.75	3.23	2.43	1.11	1.04
Ferric oxide ..	(?)	(?)	3.11	3.11	2.62	2.31
Phosphorus pentoxide ..	14.57	8.80	9.51	7.29	10.68	3.87

Although the above figures will require some correction (owing to the carbon dioxide of the various ashes not having been deducted); and although several important ash constituents, such as chlorine and sulphur trioxide, have yet to be taken into account before a final judgment can be formed, yet these percentages already teach us a good deal. In the ash of all three plants there is the same kind of difference between the white and green parts. In the ash of the white parts potash abounds, and in the ash of the green parts lime; while in the ash of the white parts there is invariably a higher proportion of phosphates than in that of the green. There is, however, no indication that the presence of chlorophyll in the green parts involves a higher proportion of iron. On the whole, the composition of the ash, as of the organic part of these plants, suggests a comparison of the white parts with the younger and more active parts of ordinary plants, while the green parts resemble the more mature organs. At present, further deductions would be hazardous, but a series of synthetical experiments on variegated plants is at once suggested by the foregoing analyses, and by the observation that, in some calcareous soils, many variegated plants quickly revert to their normal green condition. I hope before long to report the results of growing variegated plants in soils nearly destitute of lime, but abundantly supplied with potash salts and phosphates.—*Gardener's Chronicle*, p. 580, 1877.

## WHY MILK SOURS DURING THUNDER-STORMS.

By MALVERN W. ILES, Ph.D.

THERE have been various surmises with regard to this subject; none, so far as we have been able to learn, have been substantiated by experiments.

In order to see if milk really did sour during heavy rain and thunderstorms I made several observations which proved to me that the opinion so commonly held by dairy-men was not erroneous.

My experiments to arrive at the cause of the phenomena thus observed may be stated as follows:—I filled an eudiometer tube (300 c.c.) with skimmed morning's milk, then introduced 100 c.c. pure oxygen gas; then, by the use of an ordinary battery and a small Ruhmkorff coil, sparks of electricity were made to pass through the oxygen for five minutes. The current was then broken, the tube shaken up, and allowed to stand for five minutes. The milk did not appear quite so opaque, and showed a noticeable acid reaction. On continuing the current for five minutes longer, making in all ten minutes, the milk curdled very perceptibly, and showed a decided acid reaction. The contents of the tube, on standing for

twenty minutes, had reached the consistency of ordinary sour milk, or "bonny-clabber."

From the above experiments it will be seen that the oxygen was converted into ozone, which we think may be stated as the cause of the rapid souring of milk during thunderstorms.

The increased acidity is due to the formation of lactic acid, and most probably some acetic acid, by means of the ozone, one or both of these acids thus causing the casein to be precipitated.

Baltimore, November 5, 1877.

## THE ANALYSIS OF TIN ORES.

By A. E. ARNOLD.

As tin generally occurs in the form of cassiterite, it is to the analysis of this mineral, in its impure state, to which I refer.

Tin is frequently estimated in the dry way by fusion of the ore with potassium cyanide, but to ensure accuracy it is always advisable to make a second assay. The results thus obtained are not so correct as when the tin is precipitated from its solution as sulphide or hydrate.

The difficulty of obtaining dioxide of tin in solution is well known. Carbonate of soda, hydrate of soda, carbonate of potash and borax, sulphur, and carbonate of soda are each used as fluxes to render the cassiterite soluble; but this is not always effected in one fusion. When fluorhydrate of potassium or borax is used as a fondent the silica cannot be estimated, and wherever the above fluxes are employed a large quantity of fixed salts is introduced into the analysis.

By treating cassiterite, in a state of fine division, with a rather brisk current of hydrogen, at a moderate red-heat, it is completely reduced to metallic tin. If a gramme of substance is taken, about two hours' exposure will suffice. This is demonstrated by the following figures: the numbers under "Found" represent the loss of oxygen estimated by re-weighing the boats after ignition in hydrogen; under "Calculated" is the theoretical amount of oxygen present in the tin dioxide found in the sample:—

SnO <sub>2</sub> present.	Oxygen Loss.	
	Calculated.	Found.
I. 88.39 per cent.	18.66	18.30
II. 64.48 ,,	13.76	13.69

The tin present may be deduced with tolerable accuracy from the loss of oxygen incurred in the reduction. The above figures were not determined with this object, and are only cited in want of more exact determinations.

The reduced tin may be caused to act upon perchloride of iron in a flask fitted with a small valve, and the resulting protochloride of iron can be titrated with permanganate or with bichromate. It is preferable, if a complete analysis of the mineral is required, to treat the substance beforehand with hydrochloric acid or aqua regia, to remove the soluble gangue. This may consist of volatile sulphides, oxides of iron and bismuth, arsenic acid, and sulphides of copper and iron, which interfere with the volumetric estimation. The insoluble matter, consisting principally of silica and dioxide of tin, is filtered and weighed. It is easily transferred from the platinum crucible to a small porcelain boat, in which it is reduced. Six or eight boats at a time are conveniently ignited in a long glass tube bound with copper-foil.

The hydrogen is freed from all traces of sulphur and arsenic by nitrate of silver and soda-lime, and well dried. If arsenic acid is present arsenious acid sublimes in the tube, and reveals itself by its crystallisation; but some arsenic remains with the tin.

The contents of the boats, after cooling in hydrogen, are dissolved either in perchloride of iron, for titration.

or by hydrochloric acid and potassium chlorate, for the subsequent precipitation of the tin as sulphide or hydrate.

Ten or twelve volumetric estimations of tin may thus be made in the course of twelve hours. The following analyses were made in the manner described:—

Dioxide of tin .. ..	0.64	10.04	13.85	6.93	62.73
Copper oxide .. ..	None	None			
Bismuth oxide .. ..	None	—		0.28*	0.99
Lead oxide .. ..	None	None			
Arsonic acid .. ..	Trace	None	20.10	8.58	3.47
Silica .. ..	0.85	2.12	6.86	7.09	4.14
Manganese protoxide	0.22	None	—	0.97	0.22
Lime .. ..	48.20	42.72	10.65	25.58	10.77
Magnesia .. ..	0.66	0.52	—	1.22	0.53
Iron peroxide .. ..					
Alumina .. ..	12.16	7.91	43.61	25.31	9.58
Combined water .. ..				0.98	None
Moisture .. ..	1.47	2.27		5.68	3.97
Carbonic Acid .. ..					1.19
Undetermined .. ..	35.80	34.42	—	18.20	7.59
	100.00	100.00	101.03	99.82	100.69

Metallic tin .. .. 0.50 7.90 10.89 5.45 49.34

As the foregoing process is not generally known, I consider the facility with which assays of tin ores may be conducted as described is sufficient to warrant its communication.

## THE ACTION OF FIXED OILS UPON COPPER.

By Dr. EDMUNDS.

In connection with the research of Mr. W. H. Watson on this subject it will be of interest to readers of the CHEMICAL NEWS to know that a most perfect lubricating oil has long been manufactured by a special process from paraffin oil, and that this may still be obtained by writing to Charles Humphrey, the Dee Oil Company, Saltney, near Chester. This oil has no oxidising action upon brass-work, and it does not resinify. For lubricating the bearings of microscopes and other instruments I have long used this with great satisfaction, and know of nothing equal to it. Some time since I gave a specimen of it to Messrs. Powell and Lealand, the well-known makers of microscopes, and Mr. Powell has since told me that he never before met with any oil like it.

5, Savile Row, London, November, 1877.

## A STUDY OF CYANOGEN COMPOUNDS.

By SAMUEL E. PHILLIPS.

THAT a brighter future awaits the evolution of a true chemical philosophy is an article of common faith, and many will feel much indebted to Mr. Sidney Lupton for his painstaking endeavour to simplify the cyanogen series (CHEMICAL NEWS, vol. xxxiii., p. 223). Some thirty years ago it was the ruling fashion to interpret these from the point of view of either Graham or Liebig. The former held that they were salts of a peculiar acid, the equivalent of which was triple that of HCy, and containing 3Cy in the radical prussine (Pr), the 3H of the acid being replaced by metals forming the prussides, &c. The hypothesis of Liebig entertained another radical constituted of Fe<sub>1</sub> and Cy<sub>3</sub>, which combined with 2H, K, or other metals, the radical being called ferro-cyanogen (Cfy).

How partial and gratuitous these hypotheses were, and ill-fitted to cover all the ground, struck me very forcibly

\* As metals.

at the time, and I then wrote a long paper on the series; but without my puny efforts, and the laboured refutation attempted, time rolls on, and these fashions are utterly extinct. Apart from foolish conceit, which time has corrected, my pride was then as now, that the views taken really covered the widest ground, and that no special hypothesis was at all requisite. Since then the fashion has been for "atomicities" *per se* with the attendant hooks or points of attachment, and other omniscient peculiarities of type and disposition. Yet still no radical iconoclast is needed, for such worthy men as Roscoe, Friedel, and others, have rebuked the folly, and its speedy diminution will be the happy consequence.

Sidney Lupton is a Goliath in the retreating confusion, and hence the endowment of cyanogen with a startling atomicity, more than rivalling the short-lived notoriety of Hofmann's elongated types of 14 atom water.

That a special hypothesis of manifold atomicity for Cy should now be set forth is exceedingly incongruous, because it is the most purely monatomic of all its negative or acidifying congeners, and such a Quixotic endeavour might be far more easily entertained for O, Cl, or S. We might thus initiate "a new study of the chlorine compounds," "and in a general review the first thing which strikes us is the large number of compounds in which Cl plays the part of a monatomic element; the second is the numerous complicated compounds containing the atom Cl more than once. Considering, then, Cl compounds as a group to themselves, it is evidently of advantage to use as our means of classification the atoms of Cl, and not, as is usually the case, the various bodies with which it may be combined, just as the paraffins, for example, are classified by the number of atoms of carbon they contain. Our next step is therefore to enquire into the combining powers of Cl as the basis of our classification," &c.

With the above unpublished manuscript before me, I would briefly indicate some of its leading features.

Cy as the + element.

IDES— CyO — CyCl — CyBr — CyI  
CyF — CyS — CyS<sub>2</sub>, &c.

SALTS— Oxy-cyanates... .. KO.CyO  
Chloro-cyanates .. .. KCl.CyCl  
Sulpho-cyanates .. .. KS.CyS  
Per-sulpho-cyanates .. .. KS.CyS<sub>2</sub>

With corresponding bromo-, iodo-, and other salts.

Cy as the — element.

Cyan-IDES—

Analogues.				
KCy	—	KO	KCl	KS
NaCy	—	NaO	NaCl	NaS
BaCy	—	BaO	BaCl	BaS
ZnCy	—	ZnO	ZnCl	ZnS
FeCy	—	FeO	FeCl	FeS
Fe <sub>2</sub> Cy <sub>3</sub>	—	Fe <sub>2</sub> O <sub>3</sub>	Fe <sub>2</sub> Cl <sub>3</sub>	Fe <sub>2</sub> S <sub>3</sub>
PtCy	—	PtO	PtCl	PtS
PtCy <sub>2</sub>	—	PtO <sub>2</sub>	PtCl <sub>2</sub>	PtS <sub>2</sub>
AuCy <sub>3</sub>	—	AuO <sub>3</sub>	AuCl <sub>3</sub>	AuS <sub>3</sub>
		&c.	&c.	

Cyano-SALTS—

Oxy-, chloro- and sulpho-analogues.			
Cyan-aurates... ..	KCy.AuCy <sub>3</sub>	KO.AuO <sub>3</sub>	
Cyan-platinates .. ..	KCy.PtCy	KCl.PtCl	
" " .. ..	KCy.PtCy <sub>2</sub>	KS.PtS <sub>2</sub>	
Cyano-ferrates .. ..	2KCy.FeCy	2KCl.CuCl	
Cyano-ferrates .. ..	3KCy.Fe <sub>2</sub> Cy <sub>3</sub>	3KS.Fe <sub>2</sub> S <sub>3</sub>	
Cyano-cobaltates .. ..	3KCy.Co <sub>2</sub> Cy <sub>3</sub>	3KO.Co <sub>2</sub> O <sub>3</sub>	
Cyano-iridates .. ..	3KCy.Ir <sub>2</sub> Cy <sub>3</sub>	3KCl.Ir <sub>2</sub> Cl <sub>3</sub>	
Cyano-chromates .. ..	3KCy.Cr <sub>2</sub> Cy <sub>3</sub>	3KF.Si <sub>2</sub> F <sub>3</sub>	
	&c.	&c.	

In the copy we have three columns of analogues, but they are here abbreviated to economise space.

These are only a few typical selections from the fuller outline, and the principle admits of being carried to the

fullest extent, whether in mineral or organic chemistry. The paper has a separate section on the indefinite character of oxy- and sulpho-cyanates, as due to their tendency to pass into isomeric ammonia forms, and thence specially exhibiting the di- and tri-condensations characteristic of that type.

We now pass in review the manifold atomicities of this quixotic endeavour.

*Mono-cyanides*, (Cy<sub>1</sub>)<sup>I</sup>.—These call for little remark, but we may note that if CyK be a "potassium cyanide" then CyI is also an iodine cyanide! It is so notated and so classified, but is correctly called "cyanogen iodide."

*Di-cyanides*, (Cy<sub>2</sub>)<sup>II</sup>.—It may be worth while to enquire what are the essential ideas involved in this diatomic Cy? Is it regarded as a condensation analogous with the di- and tri-ammonias? and if the molecule of the monatomic group be CyCy would that of the diatomic group be Cy<sub>2</sub><sup>II</sup>Cy<sub>2</sub><sup>II</sup>?

In the first or simplest group we have sulpho-cyanic acid, CySH or HS.CyS; and in the second or more complex series we have the simple sulphide, of which the former is a compound. This group includes some of the simplest double cyanides, and by comparing them with their analogues, the prefix di will be seen to be unsuitable.

Cy<sub>2</sub>KAg is undoubtedly KCy.AgCy.

Cy<sub>2</sub>KAu " " KCy.AuCy, &c.

And the corresponding double sulphides or chlorides are in nowise considered disulphides or dichlorides!

Of the sulpho-cyanogens we have—

In the mono-cyanides "sulpho-cyanic acid," HS.CyS.

In the di-cyanides "per-sulpho-cyanic acid," HS.CyS<sub>2</sub>. But why double this latter to make it Cy<sub>2</sub>SH.S.SH? Or if there be merit in elongated symmetry why not make it Cy.SH.S.HS.Cy?

*Tri-cyanides*, (Cy<sub>3</sub>)<sup>III</sup>.—Of double and triple chlorides, as chlorides, I know nothing; while this peculiarity as affecting ammonias is indeed a familiar feature. Give them an ammoniacal interpretation and we have nothing left, for by the terms of the context (as I understand them) all such are excluded. I now propose to consider them all together.

Variations. Amine Forms

A.	Cyanamide .. ..	CyH <sub>2</sub> N	CyCu <sub>2</sub> N	CyH <sub>3</sub> N, Cl
	Di-cyanamide .. ..	Cy <sub>2</sub> H <sub>4</sub> N <sub>2</sub>	Cy <sub>2</sub> H <sub>2</sub> Cu <sub>2</sub> N <sub>2</sub>	
	Tri-cyanamide .. ..	Cy <sub>3</sub> H <sub>6</sub> N <sub>3</sub>	Cy <sub>3</sub> H <sub>3</sub> Ag <sub>3</sub> N <sub>3</sub>	
B.	Cyanic acid .. ..	(CO <sub>2</sub> )HN		
	Di-cyanic acid .. ..	(CO <sub>4</sub> )H <sub>2</sub> N <sub>2</sub>		
	Tri-cyanic acid .. ..	(CO <sub>6</sub> )H <sub>3</sub> N <sub>3</sub>		
C.	Cyanhydric acid .. ..	C <sub>2</sub> HN		
	Di-cyanhydric acid .. ..	C <sub>4</sub> H <sub>2</sub> N <sub>2</sub>		
	Tri-cyanhydric acid .. ..	C <sub>6</sub> H <sub>3</sub> N <sub>3</sub>		
D.	Chloride of Cy .. ..	C <sub>2</sub> ClN		
	Di-chloride of Cy .. ..	C <sub>4</sub> Cl <sub>2</sub> N <sub>2</sub>		
	Tri-chloride of Cy .. ..	C <sub>6</sub> Cl <sub>3</sub> N <sub>3</sub>		

Of these triplets A is probably the most definite and least open to controversy, as being well known in its ammonia or indifferent hydride forms, as also in its ammonium or saltic mono-combinations; and it is well that the student should have a clear distinction throughout these series between the metal substitution in the amide and that of the true metal base in the ammonium or true salt. This is the more incumbent, because Hofmann has regarded and notated many of these di- and tri-amides as di- and tri-basic salts!

As in natural history, a profounder knowledge leads to a grander unity, by which empirical high-sounding names become obliterated in the conception of one variable species, so I have traced the insensible transitions by which the extremes, ammonium and nitric acid, become one chemical unity; and so, with a master-hand, deserving imperishable renown, Hofmann has traced the essential unity of relation between A and B series, not only in their simplest forms, but in their substituted varieties. The A. tri-cyanamide (melamine) by three stages of re-

action involving  $+2\text{HO} - \text{H}_3\text{N}$  becomes B tri-cyanic acid (cyanuric acid)—

Melamine becomes ammeline .. ..  $(\text{CO}_2)\text{Cy}_2\text{H}_5\text{N}_3$   
 Ammeline becomes melanuric acid..  $(\text{CO}_4)\text{CyH}_4\text{N}_3$   
 Melanuric acid becomes cyanuric acid  $(\text{CO}_6)\text{H}_3\text{N}_3$ .

As we may invert the order of these transitions by inverse reactions inducing  $-2\text{HO}$ , or vary them by substituting HS for HO, it is important to have a clear grasp of the meaning and the mechanism of these reactions.

Sulph-melanuric acid .. ..  $(\text{CS}_4)\text{CyH}_4\text{N}_3$   
 $+ \text{H}_3\text{N} - 2\text{HS} = \text{sulph-ammeline } (\text{CS}_2)\text{Cy}_2\text{H}_5\text{N}_3$ , &c.

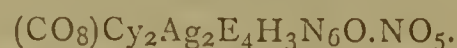
The strength of our position as against the cyanide views of Mr. S. Lupton is seen not only in the triple ammonia tendency, but more emphatically in their true saltic mono-bases, of which no account whatever is taken.

A chief characteristic of these amides is to evince an indifferent or non-combining chemical character, yet it so happens that the evidence already obtained is very much more ample and decisive than might have been expected.

We have melamine nitrate,  $\text{Cy}_3\text{H}_7\text{N}_3\text{O}.\text{NO}_5$ ; the chloro-platinate,  $\text{Cy}_3\text{H}_7\text{N}_3\text{Cl}.\text{PtCl}_2$ ; the acetate, sulphate, and others.

We have ammeline nitrate,  $\text{CO}_2\text{Cy}_2\text{H}_6\text{N}_3\text{ONO}_5$ ; the chloro-platinate,  $(\text{CO}_2)\text{Cy}_2\text{H}_6\text{NCl}.\text{PtCl}_2$ ; the acetate, oxalate, sulphate, and others.

Hofmann gives a nitrate of a base of the melanuric acid type, with 3H replaced by  $\text{E}_2\text{Ag}$ , and it is strangely called "nitrate of diethyl-ether of amido-cyanuric acid"! It has the elements of  $(\text{CO}_4)\text{CyAgE}_2\text{H}_2\text{N}_3\text{O}.\text{NO}_5$ , and he gives a nitrate of a di-condensation—

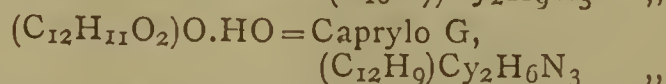
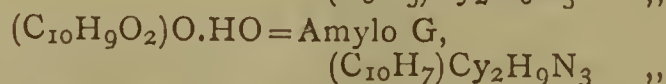
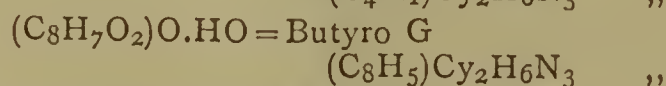
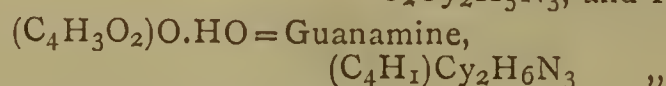
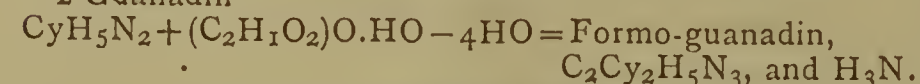


As C and D involve the idea of C=6 replacing one H of ammonia, there are two manifest reasons why the evidence as yet should be tolerably slender—first, because of its heterodox and unwelcome character; and, secondly, because of its probable rarity in the play of combinations.

The extreme nitrile radicals are unwelcome (without their corresponding high atomicities) and the facts themselves are evidently not of the common sort, considerations probably more applicable to the carbon by itself; but when this feeling of prejudice and timidity has abated the following derivatives of guanadin may be better appreciated.

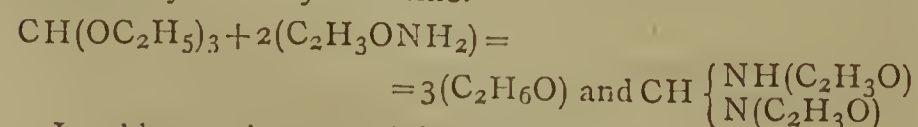
Formic, acetic, butyric, amylic, and caproic acids have been digested with guanidin to the following results:—

2 Guanadin—

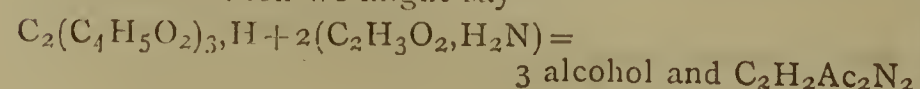


Of course our present interest centres in the formo-body (so-called), and many will be the efforts, and great the ingenuity displayed, to view this body in some other light.

M. Wichelhaus has discovered a base isomeric with "cyanide of ammonium." Its genesis is thus—"Ortho-formic acid, ether, and acetamide heated together in sealed tube at  $180^\circ \text{C}$ ," gives a white substance, which is "Methenyl-diacetyl-diamine."

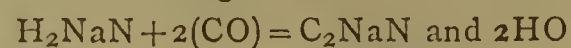


In old notation we might say—



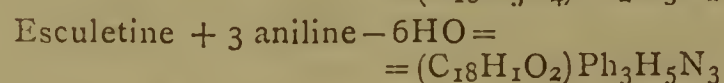
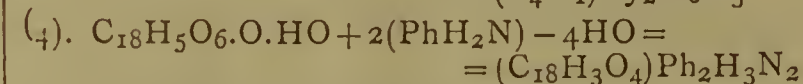
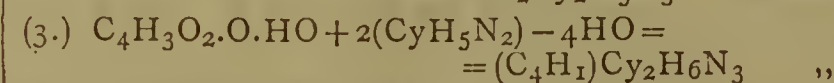
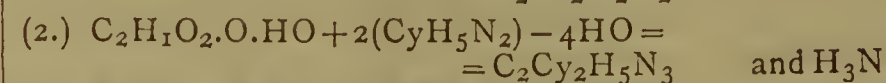
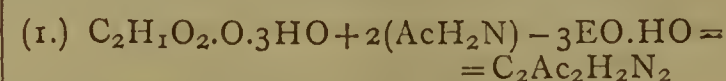
Another product of the reaction is a base  $\text{C}_2\text{H}_2\text{H}_2\text{N}_2$ , of which the platinum salt is  $\text{C}_2\text{H}_2\text{H}_3.\text{N}_2\text{Cl}_2.\text{PtCl}_2$ , or  $\text{C}_2\text{H}_5\text{N}_2\text{Cl}.\text{PtCl}_2$ . M. Wichelhaus considers this an "amido-methenyl-imide."

I cannot take these liberties with the ammonia type, and of imides I know nothing!



A platinate of this latter would apparently be identical with the platinate of M. Wichelhaus.

As this reaction has two features of special interest it may be worth while to study it from different points of view. I therefore repeat the above equation in a different form and with other comparisons, notating acetyl  $\text{Ac} = (\text{C}_4\text{H}_3\text{O}_2)$ , and phenyl  $\text{Ph} = (\text{C}_{12}\text{H}_5)$ —



If the cyanogen or acetyl of (1.), (2.), (3.), are unaffected by the reaction, I do not see what other interpretation can be given to the corresponding results. Whether the "ortho-formic acid ether" of (1.) be such, or, as might appear from the character of its genesis, a substitutional methane,  $\text{C}_2(\text{C}_4\text{H}_5\text{O}_2)_3\text{H}$ , like  $\text{C}_2\text{E}_3.\text{H}$  or  $\text{C}_2\text{H}_3.\text{H}$  is not at all clearly established; and it is rather odd that the prefix "ortho" should really mean *exceptionally* tribasic, which the ordinary formates certainly are not! Of course many will think the hypothesis of a triatomic methenyl  $(\text{C}_2\text{H})^{III}$  is valid, but it will not bear investigation.

The radicals  $\text{C}_2\text{H}_1$ ,  $\text{C}_4\text{H}_1$ ,  $\text{C}_6\text{H}_1$ ,  $\text{C}_6\text{N}_3$ , &c., are in some sense triatomic, just as gold is; but in every case they all replace one H of ammonia, and as we can now obtain  $(\text{C}_4\text{H}_3)_3\text{N}$ , so this principle in di and tri forms only awaits further extension to prove the same for all. The formo-guanamine might be  $(\text{C}_2\text{H}_1)^{III}\text{Cy}_2\text{H}_4\text{N}_3$ ; but then how is the corresponding aceto  $(\text{C}_4\text{H}_1)\text{Cy}_2\text{H}_6\text{N}_3$ ? With any collateral evidence we might accept the former as containing the 9 equivalents of a triamine, but in the second case it would necessitate 11 equivalents, which is inadmissible.

(To be continued.)

## A DELICATE TEST FOR COPPER.

By R. C. WOODCOCK.

IN the *Deuts. Chem. Ges. Ber.*, (x., 1099), a very sensitive test for copper is given, which is quite worthy of record. A zinc-platinum element is formed of two thin wires, which is then placed in the solution to be tested. Should there be much copper present, almost immediately the platinum becomes covered with a blackish deposit; but if the solution is very dilute it is necessary to leave the wires in for some hours, when of course the platinum will be only slightly, if at all, coloured. The platinum wire is now removed, washed with water, and exposed—without previous drying—for a few moments to the action of hydrobromic acid and bromine vapour, obtained by heating a small quantity of potassium bromine with strong sulphuric acid. The deposit becomes deep violet: the colour may be more easily recognised by rubbing the platinum wire upon a piece of porcelain. The author (L. Cresti) believes the colour to be due to bromide of copper dis-

solved in hydrobromic acid, and states that 0.000001 grm. Cu can be readily detected by its means.

I have repeated the experiment by dissolving metallic copper in nitric acid, and then diluting the solution until 8 c.c. contained 0.0000008 grm. Cu: 8 c.c. were then taken, and a drop of dilute hydrochloric acid added, the zinc-platinum element placed in the solution, and left for nineteen hours, after which time the Cu could just be detected by applying the above test.

## PROCEEDINGS OF SOCIETIES.

### PHYSICAL SOCIETY.

November 17, 1877.

Dr. STONE, Vice-President, in the Chair.

THE President, Prof. G. C. FOSTER, described and exhibited a very simple form of absolute electrometer, which acts on the same principle as Sir W. Thomson's trap-door form of apparatus, but can be constructed at a very moderate cost. To one arm of a balance is suspended, by silk fibres, a zinc disk, which hangs horizontally in the plane of a sheet of the same metal, forming a guard-plate; and at a distance of about 1 inch below is a flat sheet of zinc, also horizontal. An electrical connection is formed between the guard-plate and suspended disk by a bridge of very fine wire. The method of using the apparatus to determine the potential required for a spark to pass from a Holtz machine through varying thicknesses of air was explained. When the balance has been accurately counterpoised an excess weight, say 1 grm., is introduced into the scale-pan, and the guard-plate and the lower attracting-plate, as well as the two knobs of a spark-measurer, are connected with the conductors of the machine. If this be now set in action, and the knobs of the spark-measurer be gradually separated, a point will be reached at which the attraction upon the suspended disk just overcomes the excess weight in the balance-pan. The length of spark for which this occurs can now be read off. The difference of the potential causing the spark is given by the formula—

$$\frac{e}{a} \sqrt{8F},$$

where  $a$  is the radius of the attracted disk,  $e$  its distance from the attracting-plate, and  $F$  the force of attraction in dynes. In the apparatus exhibited  $a$  had the value 5.195 c.m., and  $e$  the value 2.4 c.m., whence if  $w$  be the excess weight in grammes—so that  $F=981w$ —the difference of potential becomes  $39\sqrt{w}$ . The proper action of the apparatus depends essentially upon the attracted disk being accurately in the same place with the guard-plate. To facilitate this adjustment each of the silk fibres by which the disk is suspended is attached to a screw, by which it can be separately raised or lowered; and by means of another screw the small brass plate holding the suspending screws can be raised or lowered as a whole. A few numerical results were given to illustrate the action of the apparatus: these were taken from a set of experiments in which the difference of potential needed to produce sparks in air between two equal brass spheres of 2.61 c.m. radius was measured. The following are the results for a few of the shortest and longest sparks measured:—

Length of Spark.	Difference of Potential.	Mean Electrical Force.
0.1325 c.m.	17.4	131.0
0.1825 "	20.4	117.0
0.2370 "	24.6	104.0
..	..	..
..	..	..
0.6800 "	62.9	93.0
0.7100 "	65.2	92.0
0.740 "	68.7	93.0

## DEUTSCHE CHEMISCHE GESELLSCHAFT, BERLIN.

October 29, 1877.

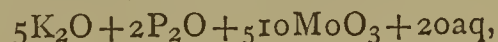
Professor C. LIEBERMANN, Vice-President, in the Chair.

THE following communications were presented:—

C. RAMMELSBERG, "*Atomic Weight of Molybdenum, and Composition of the Phospho-Molybdates.*" By reduction of molybdic acid in H, the author obtains the atomic weight  $\text{Mo}=96$ , coinciding with Berzelius's determinations, and in opposition to the number 92, used by Fresenius and most analysts at present. In order to settle the vexed question with regard to the structure of the ammonium phospho-molybdate used in the determination of phosphoric acid, he carried out a number of analyses, not only of this salt, but of the corresponding potassium salt. The average of the results led to the following molecular relations:—

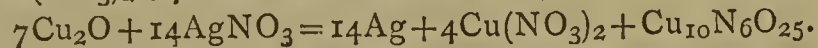
	$\text{R}_2\text{O}$ .	$\text{P}_2\text{O}_5$ .	$\text{MoO}_3$ .	$\text{H}_2\text{O}$ .
Ammonium salt ..	9.98	1	21.9	11.7
Potassium salt ..	2.80	1	22.2	11.7
Or .. .. .	3.00	1	22.0	12.0

viz.,  $3\text{R}_2\text{O} + \text{P}_2\text{O}_5 + 22\text{MoO}_3 + 12\text{aq}$ . The colourless salt obtained from ammonium molybdate, phosphoric acid, and excess of ammonia, was found to possess the composition  $3\text{Am}_2\text{O} + \text{P}_2\text{O}_5 + 5\text{MoO}_3 + 7\text{aq}$ , while the corresponding white potassium salt formed on addition of HKO to the yellow phospho-molybdate was  $5\text{K}_2\text{O} + \text{P}_2\text{O}_5 + 15\text{MoO}_3$ . A salt corresponding to the colourless ammonium salt was obtained by melting  $1\text{K}_2\text{CO}_3$  with  $2\text{MoO}_3$ , and adding  $\text{P}_2\text{O}_5$  to the solution; and a white salt,—



formed by adding a small amount of HKO and  $\text{P}_2\text{O}_5$  to  $\text{K}_2\text{Mo}_3\text{O}_{10}$ .

"*Estimation of Cuprous Oxide in Copper.*" The proposal of Hampe to determine the  $\text{Cu}_2\text{O}$  in crude copper by treatment with a solution of  $\text{AgN}_3$  is regarded as unreliable by the following test:—A weighed amount of  $\text{Cu}_2\text{O}$  was digested with an excess of  $\text{AgNO}_3$ . The filtrate contained then 28.8 per cent of the Cu, while the remainder was precipitated with Ag in the form of a basic nitrate,  $3\text{Cu}(\text{NO}_3)_2 + 7\text{CuO}$ , the reaction being—



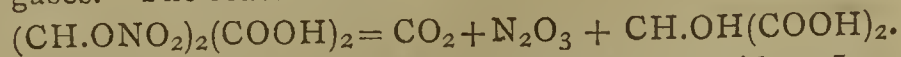
H. WICHELHAUS defends his position with regard to the "*Formation of Quin-hydrone,*" in connection with Liebermann's late researches (CHEMICAL NEWS, vol. xxxvi., page 51).

R. SCHIFF and G. TASSINARI, "*Ammoniacal Derivatives of the Chlorals.*" Butyl-chloral-ammoniac and acetic anhydride, as well as butyl-chloral and acetamide, yield the same acetyl-butyl-chloral-ammoniac,—



insoluble, snowy white crystals, melting at  $158^\circ$ . These results, coinciding with those in the ethylic series, show that the addition-products of the chlorals and acid-amides are identical with the compounds obtained by introducing acid radicals into the amide group of the corresponding chloral ammoniac. It is further ascertained that the bromals possess this property in common with the chlorals. The reaction-products of aldehyds and chloral-ammoniac gave no satisfactory results.

E. DEMOLE, "*Tartronic Acid.*" This acid is prepared easily by heating dinitro-tartaric acid with dilute alcohol, and allowing to cool on the cessation of the formation of gases. The reaction is—



"*Etherification by means of Hydrochloric Acid at Low Temperatures.*" The reactions between acetic acid and ethylic or amylic alcohol can be carried out perfectly at  $0^\circ$ . At this temperature acetyl chloride is likewise formed when HCl is led through a mixture of phosphoric anhydride and acetic acid. Hence the author judges that in

etherification at low temperatures by means of HCl the acid chloride is first formed, which then gives with the alcohol the desired ether.

G. NEUHÖFFER and G. SCHULTZ, "*Action of Amines on Chlorinated Quinons.*" After recounting the literature of quinon-amines, the authors describe the reactions with trichloro-quinon. The alcoholic solution forms with aniline, toluydin, benzidin, naphthylamine, &c., precipitates which dissolve in concentrated  $\text{H}_2\text{SO}_4$ , yielding bright blue solutions. The aniline derivative has been examined and found to be dianilido-mono-chloro-quinon.

C. WURSTER, "*The Sizing of Paper.*" This operation is at present chiefly carried out by means of a mixture of alum and resin-soap, *i.e.*, sodium salts of the various acids in colophonium, the sizing being regarded as due to the alumina salts of these acids, which are thereby formed. The author finds from analyses of sized paper that, on the contrary, the sizing is due to uncombined resin, and that the resin can be obtained in a state of suspension in water where the particles are so fine that they pass through filter-paper, which is admirably adapted for sizing, possessing remarkable anti-capillary properties. Successful sizing depends on dissolving the colophonium in such a manner that by dilution the resin is not precipitated in flocculent masses, but forms a milky liquid. Paper treated with this preparation is sized towards water and weak acids, but not towards alkalies or other liquids dissolving resin. The ink used should therefore be slightly acid.

R. ANSCHÜTZ and G. SCHULTZ describe a convenient "*Apparatus for Determining Fusing-points.*" It consists of a small rounded flask, into the neck of which is melted a test-tube reaching nearly to the bottom of the flask. A tubulus on the side communicates with the air, and is occupied by a long narrow tube when the apparatus is heated, and by a chloride of calcium tube when not used. The interior is filled to the half with sulphuric acid or paraffin. The capillary tubes containing the substances with the thermometer are placed in the test-tube on a pad of asbestos, and the apparatus slowly heated. The advantages are—reliability of results in consequence of the rapid equalisation of the temperature in the test-tube, and freedom from unpleasant vapours when determining high melting-points.

"*Action of Sodium on Halogen Anilines.*" In the ortho, meta, and para series this reaction gives rise exclusively to azo-benzene. The authors considered that this result was due to the formation of the intermediate  $\text{C}_6\text{H}_5\text{NHNa}$ , which was oxidised by the air to  $\text{C}_{12}\text{H}_{10}\text{N}_2$  and  $\text{NaOH}$ , and found, in fact, that azo-benzene was formed by passing a stream of air through an ethereal solution of  $\text{C}_6\text{H}_5\text{NHK}$ .

J. BÖHM, "*Formation of Starch in the Leaves of the Scarlet Runner.*" The experiments adduced show in opposition to the hitherto accepted theory of the formation of the starch in the chlorophyll cells, resulting entirely from the direct assimilation of  $\text{CO}_2$  and  $\text{H}_2\text{O}$  in sunlight, that in the case of the scarlet runner, when the leaves are deprived of light, the starch disappears entirely from the cells, but is replaced in the course of a few weeks by contributions of starch from cells in other parts of the plant exposed to the sunshine.

H. VOHL describes a simple "*Apparatus for the Determination of the Acetic Acid in Vinegar.*" consisting of a flask provided with a  $\text{CaCl}_2$  tube, and closed by a caoutchouc stopper, through which passes a glass rod terminating in a platinum hook, and supporting a tube of sodic bicarbonate. The apparatus is weighed alone, the vinegar added, and after weighing the bicarbonate lowered into the liquid. The resultant  $\text{CO}_2$  is removed entirely by suction, and the final weighing takes place.

"*Determination of the Impurities of River- and Spring-Water.*" For the purpose of examining the impurities in the Rhine, the author makes use of the boiler incrustations and boiler residues of the steamers on the river. Arsenic,  $\text{H}_2\text{S}$ , and a variety of other poisonous and injurious compounds were detected, while the large percentage of phosphoric acid showed that the Rhine was bearing to the sea

enormous quantities of valuable fertilising matter. In tests for impurities resulting from the propinquity of gas-works, it must be borne in mind that by filtration through the earth the liquid refuse from the manufacture of gas loses its  $\text{S}(\text{NH}_4)_2$ , and empyreumatic constituents entirely, while quantities of magnesia are dissolved from the soil, and the ammoniac is partially changed into  $\text{HNO}_2$ . The analyst must notice particularly, then, the amount of  $\text{NH}_3$ , an unusually high percentage of  $\text{MgO}$  and  $\text{HNO}_2$ , and the presence of hyposulphurous acid.

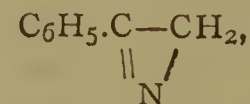
G. GÖTTIG obtains "*The Salicylic Ether of Glycerin.*"  $\text{C}_6\text{H}_4.\text{OH}.\text{CO}.\text{OC}_3\text{H}_5(\text{OH})_2$ , by passing HCl through a saturated solution of salicylic acid in glycerin at  $100^\circ$ . It is a colourless odourless liquid, giving a violet colour with  $\text{Fe}_2\text{Cl}_6$ .

A. NAUMANN continues his observations on the "*Distillation of Liquids by means of Steam*" (CHEM. NEWS, xxxvi., 212), and finds that turpentine oil (boiling at  $160^\circ$ ) is distilled in this manner at  $94^\circ$  in a mixture containing 42 per cent  $\text{H}_2\text{O}$ , and that  $\text{CCl}_4$  (boiling at  $76^\circ$ ) is distilled at  $66^\circ$ , the distillate containing 6 per cent  $\text{H}_2\text{O}$ .

E. SCHUNCK and H. RÆMER has obtained several derivatives of "*Flavo-purpurin.*" showing its non-identity with the isomeric iso-purpurin. Diacetyl, triacetyl, and dibenzoyl compounds are described. Bromine gives rise to tribromo-flavo-purpurin,  $\text{C}_{14}\text{H}_5\text{Br}_3\text{O}_5$ . Purpurin forms a mono-bromo- and iso-purpurin a dibromo-compound.

G. LUNGE and F. SALATHE have determined the "*Amount of Sulphuric Anhydride formed in Roasting Iron Pyrites*" by conducting the resultant vapours through a normal iodine solution, in which the amount of  $\text{SO}_2$  oxidised to  $\text{SO}_3$  is ascertained by titration, and the total amount of  $\text{SO}_3$  determined as  $\text{BaSO}_4$ . This method was found to be the only satisfactory one by which the two oxidation-products of S could be determined alongside each other. Experiments with pyrites showed that 18 per cent of the S is changed into  $\text{SO}_3$  when the gases pass over a layer of heated  $\text{Fe}_2\text{O}_3$ , while but 6 per cent appears as  $\text{SO}_3$  when the  $\text{Fe}_2\text{O}_3$  is absent.

W. STAEDEL prepares "*Chlor-acetyl-benzene*" by conducting Cl through the vapours of acetophenon. 300 grms. of the latter yielded 250 grms. of  $\text{C}_6\text{H}_5.\text{CO}.\text{CH}_2\text{Cl}$ , the melting-point of which is found to be  $58^\circ$ . By the action of ammonia on chloracetyl-benzene the author obtains small quantities of "*Iso-indol.*" which possesses the composition of the indol derived from indigo, and apparently an analogous structure. Its formation results from the loss of water by the amide,  $\text{C}_6\text{H}_5.\text{COCH}_2.\text{NH}_2$ , derived from chloracetyl-benzene. The various reactions point to the structure—



which if true would make it a member of the meta-nitriles, a class as yet embracing but two or three representatives.

H. PRÆTORIUS obtains by the "*Action of Fuming Nitric Acid on Benzo-phenon.*" or benz-hydrol, two new dinitro-benzo-phenons, melting at  $148^\circ$  and  $189^\circ$ , making the total number three.

C. BECK, "*Dioxy-diphenyl-methan.*" This new phenol,  $\text{CH}_2(\text{C}_6\text{H}_4\text{OH})_2$ , is obtained from diphenyl-methan, and forms a yellowish white powder. Sodium salts, methyl and ethyl ethers, acetate and benzoate, are described. Br yields a tetra-bromo-dioxy-diphenyl-methan. Chromic anhydride oxidises the ethyl-ether to diethoxyl-benzo-phenon,  $\text{CO}(\text{C}_6\text{H}_4.\text{O}.\text{C}_2\text{H}_5)_2$ , while the phenol itself is changed by fusion with  $\text{HKO}$  into  $\text{C}_6\text{H}_5\text{OH}$  and paroxy-benzoic acid.

A. ATTERBERG and O. WIDMAN, "*New Chloro-naphthalins.*" The authors have applied their processes of exchanging  $\text{NO}_2$  groups for Cl by means of  $\text{PCl}_5$ , and of introducing Cl into the naphthalen group by submitting additive compounds with Cl to the action of alcoholic  $\text{HKO}$ .  $\gamma$ -Dichloro-naphthalen, exposed to the action of

Cl in a  $\text{CCl}_3\text{H}$  solution, yields  $\gamma$ -dichloro-naphthalen-tetrachloride, and trichloro-naphthalen-dichloride,—



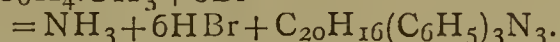
This latter yields, with  $\text{HKO}$ ,  $\delta$ -tetrachloro-naphthalen, the nitro-derivative of which gives, with  $\text{PCl}_5$ ,  $\beta$ -tetrachloro-naphthalen,  $\text{C}_{10}\text{H}_3\text{Cl}_5$ . Oxidation changes this into trichloro-phthalic acid. A fifth tetra-chloro-naphthalen ( $\epsilon$ ) arises from the action of  $\text{PCl}_5$  on dinitro- $\gamma$ -dichloro-naphthalen.

H. BRUNNER and R. BRANDENBURG, "*Methyl-Violet*." The authors obtain this dye by the action of bromine on dimethyl-aniline, in the form of a tetramethyl-rosanilin-tetra-hydrobromate,—



It dyes a handsome blue-violet, colouring perfectly ten times its weight of silk. By heating the  $\text{HBr}$  is gradually lost, and redder shades are obtained. A handsome blue-green resulted from heating together 3 mols. dimethyl-aniline, 3 mols. benzyl-chloride, and  $2\text{Br}_2$ , at  $120^\circ$ . Blue dyes were obtained by introducing but 1 or 2 mols. of benzyl.

"*Diphenylamine Blue*." This is prepared as follows:—  
 $2(\text{C}_6\text{H}_5)_2\text{NH} + 2\text{NH}_2\cdot\text{C}_6\text{H}_4\cdot\text{CH}_3 + 6\text{Br} =$



The purified substance is almost insoluble in water; it yields, however, a sulphonic acid with soluble salts, which impart a deep blue.

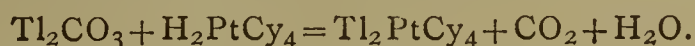
R. MALY obtains "*Sulphydantoic Acid*,"—



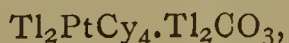
by adding ammonia to a gently-warmed mixture of sulpho-urea and monochlor-acetic acid, and digesting for a few hours. It is soluble in small quantities in hot water, and forms no stable salts.

A. FRIEDEL, J. CRAFTS, and E. ADOR describe a "*Synthetic Preparation of Benzoic Acid and Benzophenon*," by the action of  $\text{COCl}_2$  on  $\text{C}_6\text{H}_6$  in the presence of aluminium chloride. The chief product is  $\text{CO}(\text{C}_6\text{H}_5)_2$ , which can be prepared technically according to this method. The  $\text{C}_6\text{H}_5\text{COCl}$  which is formed is chiefly changed, by contact with benzene, into  $(\text{C}_6\text{H}_5)_2\text{CO}$  and  $\text{HCl}$ .

R. J. FRISWELL and A. J. GREENAWAY, "*Thallium-platinum Cyanide*." The authors prepare this salt, which is colourless, as follows:—



By doubling the amount of  $\text{Ti}_2\text{CO}_3$  the salt—

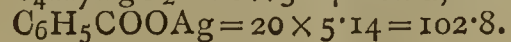
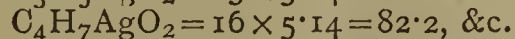
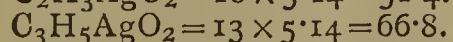
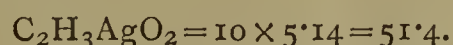


crystallising in red needles, is obtained. Carstanjen has wrongly regarded this compound as the simple cyanide.

CHICHESTER A. BELL, "*Pyrrol Derivatives*." The mono-methyl, ethyl, and amyl derivatives have been obtained by the distillation of the corresponding monamines of mucic acid, and are accompanied by small quantities of dimethyl-, diethyl-, and diamyl-carbopyrrol-amid, as well as substituted carbo-pyrrolic acids.

P. GRIESS describes his preparation of "*Ortho-azobenzoic Acid*," and shows, in opposition to the statements of Claus and Fittica, that in its properties and those of its salts it is strikingly different from the para and meta acids.

H. SCHRÖDER, "*Simple Relations between the Volumes of Organic Silver Salts*." These volumes are all multiples of  $5\cdot14$ , the volume unit of silver, differences of  $\text{CH}_3$  in the normal series, corresponding to  $3 \times 5\cdot14 = 15\cdot4$ . For example:—



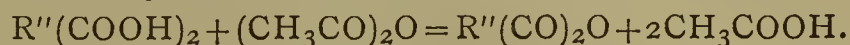
P. V. LEPEL detects the "*Colouration of Wine with the Juice of the Red Beet-root*," through the spectroscopic reaction. The solution in wine yields two prominent

absorption-bands,  $\alpha$  having its maximum between D and E, and  $\beta$  having its maximum close to F. The spectra formed on the addition of  $\text{CuSO}_4$  and alkalies are also given.

H. KLINGER, "*Thialdehyds*." Stilbene,  $(\text{C}_6\text{H}_5)_2\cdot\text{C}_2\text{H}_4$ , is easily prepared in quantities from the amorphous  $\alpha$ -benzo-thialdehyd by first changing the latter, through the action of small quantities of I, into the isomeric  $\beta$ -benzo-thialdehyd, and then heating with twelve times the amount of powdered Cu. The trimolecular acethialdehyd,  $(\text{CH}_3\cdot\text{CHS})_3$ , forms, like the normal sulphides, trimethyl-sulphinic iodide on heating with  $\text{CH}_3\text{I}$ .

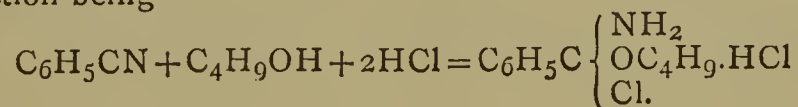
"*Action of Methylic Iodide on Sulphur*." The reaction gives trimethyl-sulphinic iodide,  $(\text{CH}_3)_3\text{SI}$ , which forms double salts with  $\text{PtCl}_4$  and  $\text{AuCl}_3$ .

R. ANSCHÜTZ, "*Action of Acetyl-chloride and Acetic Anhydride on Dibasic Acids*." Acetyl-chloride is without effect except with camphor acid, the anhydride of which is formed. Acetic anhydride gives rise to the formation of the anhydrides of dibasic acids, as follows:—



In this manner diphenic, succinic, phthalic, and camphoric anhydrides were prepared. Acetic anhydride yielded, with dibromo-succinic acid, mono-bromo-maleic anhydride, which formed iso-bromo-maleic acid by the action of  $\text{BrH}$ . Succinic anhydride was obtained by the action of succinic chloride on succinic acid, and benzoic anhydride by the action of benzoyl chloride on oxalic acid.

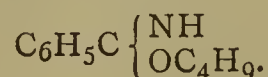
A. PINNER and F. KLEIN, "*Transformation of Nitriles into Imides*." The authors describe a new and general reaction for the preparation of a new class of bodies termed "imido-ethers." It consists in the action of dry  $\text{HCl}$  on mixtures of equivalents of nitriles ( $\text{CH}_3\text{CN}$ ,  $\text{C}_2\text{H}_5\text{CN}$ , &c.) with alcohols, chlorals, aldehyds, and organic acids. The reaction with benzo-nitrile and isobutyl alcohol has been studied more particularly. The entire mixture has been changed into a mass of crystals, the reaction being —



By treatment with  $\text{NH}_3$  the compound yields benzimido amide hydrochlorate,—



and benzimido-isobutyl ether,—



## NOTICES OF BOOKS.

*Agendas Dunod*. No. 4, *Arts et Manufactures, Chemie*. Paris: 1877.

THE introduction to the last issue of this little book contains a striking exemplification of the vitality of a lie long after it has been proved to be what it is, and when everyone who has been concerned in its refutation had thought it was dead and buried. In a chapter on the spectroscope, a very meagre and old-fashioned one by the way, which has been extracted from MM. Boutan and d'Almeida's "*Cours Élémentaire de Physique*" in order to puff that work, the following passage occurs *à propos* of the discovery of the metal thallium:—"Plus tard, au mois de Mai, 1862, M. Lamy arrive par l'emploi de la même méthode, à l'erolement d'un troisième métal le *thallium*, qu'il a pu extraire en quantités assez considérables des bones des chambres de plomb recueillies dans une usine on l'on prépare l'acide sulfurique pas la combustion des pyrites de fer. Avant lui, M. Crookes avait aperçu il est vrai la

raie caractéristique du thallium, en opérant sur les résidues de certains seleniums, *mais il n'avait pu l'isoler et considérant même ce corps comme un métalloïde analogue au sélénium et au tellure.*" The italics are our own. This gross misstatement of the facts of the case is precisely similar to that made by M. Dumas in his report to the French Academy of Sciences (*Comptes Rendus*, lv., p. 866, Dec. 15, 1862) nearly fifteen years ago, and fully refuted by Mr. Crookes in the *Phil. Mag.* for July, 1863 (4th series, vol. xxvi.)

The over-zealous action of M. Lamy's injudicious friends was greatly blamed at the time, and the refutation of his misstatements was endorsed by all the leading scientific men of that day. In spite of all this, however, MM. Boutan and d'Almeida have continued to publish the paragraphs we have noticed in every successive edition of their "Cours de Physique" issued since 1863, the last being the fourth. MM. Boutan and d'Almeida seem to be particularly chary of allowing foreign chemists and physicists their proper due, for although M. Janssen's discovery of a method of examining the solar protuberances at any time when the sun is above the horizon is mentioned, the fact that Mr. J. Norman Lockyer made the same discovery quite independently is utterly ignored, notwithstanding that M. Janssen himself was the first to acknowledge that Mr. Lockyer was entitled to as much credit as himself.

While on this subject we regret to say that in the last edition of Mrs. Somerville's "Physical Geography," just published by Mr. Murray, the discovery of thallium is placed to the credit of M. Lamy alone. For an English edition to make such a blunder is unpardonable.

The rest of the "Agenda" is made up of extracts from works published by M. Dunod, interspersed with some really valuable tables. There is also a diary appended, which will be found useful. The book is published in Paris for the low price of one franc: we cannot, therefore, quarrel with M. Dunod for strewing it with advertisements which crop up in unexpected places. Had a little more care been exercised by the editor of the book we should not meet with such misprints as *fuschine*, *nepeuthes*, *xantium*, *Bunzen*, *Kirchoff*, &c. Sydney Smith said it would require a surgical operation to get a joke into the heads of some people; it would require many to make a Frenchman spell foreign words and names with any approach to correctness. We are bound to say, however, that these blunders do not seem to extend to the tables, which as far as we have examined them are correct. Being a French scientific book it is almost needless to say that it is without an index.

*The Chemistry of the Brewing-Room, &c., with Tables of Alcohol-Extract and Original Gravity.* By CHARLES H. PIESSE, F.O.S. London: Trübner and Co., Ludgate Hill. 1877.

THIS little work contains the substance of a course of lectures delivered by the author to several classes of practical brewers, and claims to teach all the chemistry that it is needful for a practical brewer to know. The work begins with a chapter explaining the various chemical terms used in the lessons, and describing the necessary apparatus for carrying out the experiments. The general examination of worts and beers is next treated of, the processes for the determination of the amount of saccharine extract, alcohol, ash, and chlorine in the ash being described at length. The estimation of alcohol in beers is next described, copious tables showing the specific gravity of certain percentages of water and alcohol, both by weight and volume, and their equivalent in percentages of proof-spirit. A special chapter is devoted to the difficult subject of the determination of the original gravity, or the specific gravity of the wort before fermentation, the drawback allowed by the Excise on exported beers being calculated on these data, and not on the alcoholic strength of the beer at the time of shipment. Water analysis re-

ceives a large amount of attention, processes for the estimation of the nitrates, nitrites, chlorine, total solids, and permanent hardness being given. The Appendix contains a number of tables and useful hints. As an introduction to the study of chemistry of brewing Mr. Piesse's little book may be recommended.

*The Spectroscope and its Work.* By RICHARD A. PROCTOR. London: Society for Promoting Christian Knowledge. 1877.

THIS little book forms one of a series of Manuals of Elementary Science now in course of publication by the Society for Promoting Christian Knowledge. The strides which Spectroscopy is making daily necessarily causes well-known works on the subject to become prematurely old: we are not therefore greatly surprised to find that a notable number of new discoveries and instruments are described by Mr. Proctor, for which we should look in vain in the standard works of Lockyer, Schellen, Huggins, Roscoe, and others. Beginning with the analysis of light and the solar spectrum, Mr. Proctor leads his reader through the discoveries of Wollaston, Fraunhofer, Brewster, Miller, Stokes, and others, down to the detection of rubidium and caesium by Bunsen and Kirchhoff. The constituents of the sun's atmosphere and corona are then described, the reasons why they cause dark lines on the spectrum being clearly explained. The next chapter is devoted to an account of the spectra of the stars and other celestial objects, the different forms of star-spectroscopes being fully described and illustrated.

The atmospheric lines in the solar spectrum, as well as those of the atmospheric phenomena such as lightning and the aurora, next receive attention, and are followed by a capital chapter on the very difficult subject of the measurement of the motions of recession and approach of the heavenly bodies, explained with the author's usual lucidity. The little book is a truly wonderful shilling's worth. It contains 128 pp. of closely but clearly printed matter, illustrated by more than seventy woodcuts. There is also a chromo-lithograph of 14 different spectra as a frontispiece. The information in the work is brought down to the very moment of publication by the addition of several addenda containing the latest discoveries in spectroscopy. Unfortunately the book was issued only just before the news of Professor Clarke's capital discovery of the existence of oxygen in the sun's atmosphere.

*Butter, its Analysis and Adulterations, specially treating on the Detection and Determination of Foreign Fats.* By OTTO HEHNER and ARTHUR ANGELL. Second Edition. London: J. and A. Churchill.

METHODS for the determination of superfluous water or excessive salt in butter are undeniably useful; but in these days, when animal fats are not merely mixed with the produce of the dairy, but even take its place altogether, something more is urgently needed. This important want Messrs. Hehner and Angell have endeavoured to supply. Their method is founded on the principle that the fatty acids of butter are of two different classes, the so-called insoluble, which form about 87.5 per cent of the butter-fat, and the soluble—so-called because they dissolve more or less easily in water—or volatile, which amount to 6 to 7 per cent. If, therefore, butter is adulterated with a fat containing no volatile fatty acids, or a smaller proportion than is found in genuine butter, the percentage of the latter will suffer a corresponding reduction. To render this method trustworthy it must first be shown that the amount of volatile acids in genuine butters is approximately constant. The analysis of Bromeis, which has been very generally quoted or depended upon, makes the total of these acids only about one-fourth part of the pro-

portion given by our authors, but there are certain reasons for supposing that his determinations are not absolutely trustworthy. Thus the substance which he pronounced margarin has been said to have retained volatile acids. Mr. Wanklyn appears to doubt whether these soluble or volatile acids are really present as such in butter, or are rather produced by the action of the alkali employed for saponification, upon the higher fatty acids. For such a supposition the authors consider there is no valid reason, though they admit that butyric acid does not exist in butter-fat as butyrate of glycerin. If, then, we assume as proved the relatively large and constant quantity of volatile acids present in butter, and admit that the substances selected as sophistications will contain a very much smaller proportion of such volatile acids, the author's process must be regarded as rational and feasible. In practice Messrs. Hehner and Angell determine experimentally not the "soluble" or "volatile" acids, but the "insoluble" or fixed. If their amount exceeds 87.5 per cent upon the total fatty matters the case becomes suspicious, though it is scarcely judicious to pronounce a sample adulterated if the insoluble fatty acids do not exceed 88.5 per cent. Still the authors consider that "about 15 per cent of foreign animal fat may be added to a butter rich in soluble acids," the product being then equal to genuine butter of the lowest quality. They mention one fat, cocoa-nut oil, which contains a relative amount of soluble acids equal to that of butter, and which therefore, if used as an adulterant, could not be detected by their process. We scarcely think, however, that this oil is likely to be largely used for such a purpose.

The specific gravity of butters may, in the opinion of the authors, be used as an auxiliary test. In a series of experiments performed by Mr. Bell the specific gravity of butter-fat was found to range between 911 and 913, rarely falling below 910. On the other hand, the specific gravity of ordinary fats varied from 902.83 to 904.56. The experiments were performed at 100° F. (=37.8° C.), which the authors think far too low to be convenient.

The microscopic examination of butter and the determination of the melting-point Messrs. Hehner and Angell do not consider as conclusive.

## CORRESPONDENCE.

### MARBELLA IRON ORE.

To the Editor of the Chemical News.

SIR,—About a year since I published a series of analyses of iron ores, &c., used in the Scottish iron manufacture, and, among the magnetic ores, I accidentally gave as Marbella ore the analysis of a mineral obtained some miles from Marbella, and differing from the ordinary ore in containing a considerable quantity of combined water. My attention having been called to the error, I have to ask you to do me the favour of giving the following, which may be considered a typical analysis of Marbella ore of the best quality as imported into this country:—

Peroxide of iron .. .. .	61.00
Protoxide of iron .. .. .	25.20
Magnesia .. .. .	1.70
Alumina .. .. .	3.56
Silica .. .. .	7.84
Combined water .. .. .	0.28
	99.58
Iron .. .. .	62.30

The ore usually contains traces of lime, oxide of manganese, and bisulphide of iron, and an almost inappreciable trace of phosphoric acid.—I am, &c.,

WILLIAM WALLACE.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 20, November 12, 1877.

Observations on the Principle of Maximum Work and on the Spontaneous Decomposition of Hydrated Binoxide of Barium.—M. Berthelot.—The stability of anhydrous peroxide of barium appears from the following figures. A sample prepared in January, 1874, contained at the moment of its preparation 9.4 per cent of oxygen in excess above what is found in baryta. In November, 1877, there was found 9.2 per cent. It is different with the hydrate  $\text{BaO}_2 \cdot 7\text{HO}$ . This compound, prepared in a state of great purity and preserved moist, as obtained by precipitation and pressure, is gradually decomposed. Gaseous bubbles form in the mass with slight intermittent projections; the oxygen accumulates in well-stoppered bottles, so as to occasion a considerable pressure, which would in time doubtless burst the vessels. At the same time there are formed in the mass crystalline and compact clots of the hydrate  $\text{BaO} \cdot 10\text{HO}$ . If baric peroxide is preserved under a layer of water the decomposition and the evolution of oxygen are much more rapid. In some samples prepared in January, 1874, the excess of oxygen, by November, 1877, was found to have fallen from 8 per cent to 6.5 and 6.1, about one-fifth of the peroxide having become decomposed. This decomposition had been retarded by the formation of the crystalline hydrate of baryta, which requires 10 equivs. of water, and therefore tends to dehydrate the neighbouring portions of peroxide, which only contains 7 equivs. of water. The portions of peroxide thus dehydrated remain imprisoned in the hydrate of baryta formed simultaneously. If these causes of the arrest or of the retardation of the process are avoided by the presence of a sufficient excess of water, the spontaneous decomposition is much more rapid. In a portion of the same preparation which had been preserved in a bottle under a layer of water the proportion of oxygen had fallen from 8 per cent to 0.28. No carbonate of baryta had been formed, which of course excludes the intervention of the atmospheric carbonic acid. These phenomena might be foreseen on the principle of maximum work, since the decomposition of anhydrous baric peroxide absorbs heat,  $\text{BaO}_2 = \text{BaO} + \text{O}$ : absorbs -6.05. Consequently this decomposition cannot take place without the intervention of extraneous energy, borrowed in the act of heating. On the contrary the transformation of baric peroxide into the monohydrate of baryta and free oxygen liberates heat.  $\text{BaO}_2 + \text{HO} = \text{BaO} \cdot \text{HO} + \text{O}$ : +2.0 cal. 76 liquid water + 2.0 solid water, a relation which explains the direct displacement of oxygen by gaseous water, as observed by Boussingault. In this latter condition where the physical state of the two bodies which replace each other is the same, the heat liberated rises to +7.6. In the same manner in the higher hydrates,  $\text{BaO}_2 \cdot 7\text{HO} + 3\text{HO} = \text{BaO} \cdot 10\text{HO} + \text{O}$ : +5.3 cal. liquid water + 3.2 solid water. This last reaction is so much the more easy, as the monohydrate of baryta when once formed retains its water even at dull redness; whilst the hydrated peroxide of barium loses all its water in a vacuum without giving off a sensible amount of oxygen if the operation is sufficiently rapid. Thus the transformation of the hydrated peroxide takes place spontaneously at an ordinary temperature. It is effected more rapidly in presence of a proportion of water capable of dissolving the hydrate of baryta as formed, so as to permit the reaction to go on. The pure hydrate of peroxide of barium is transformed more slowly, as each molecule of crystalline hydrate of baryta borrows for its formation a certain proportion of water from the adjacent molecules

of peroxide,  $10(\text{BaO}_2, 7\text{HO}) = 7(\text{BaO}, 10\text{HO}) + 7\text{O} + 3\text{BaO}_2$  liberates: +9.5. The peroxide thus dehydrated remains unless an excess of water contained in the mass does not gradually reach it by infiltration through the crystalline hydrate of baryta with which it is surrounded.

Limits of Etherification.—M. Berthelot.—Reserved for insertion in full.

Quantities of Heat Evolved from Mixtures of Sulphuric Acid and Water.—E. Maumené.—According to the author sulphuric acid recently heated does not liberate the same amount of acid with water as an identical acid which has been preserved for some months. This phenomenon seems to him to introduce into thermo-chemical researches a source of error of which no account has been taken.

*Bulletin de la Societe Chimique de Paris,*  
Nos. 8 and 9, November 5, 1877.

Quercetagetin, the Yellow Colouring-Matter of the Flower of *Tagetes Patula*.—MM. Latour and Magnier de la Source.—This compound approaches very closely to quercetin. It is extracted from the flowers of *Tagetes patula* by a long and tedious process, and when perfectly pure has the composition—

C	..	..	..	..	..	..	58.50
H	..	..	..	..	..	..	3.97
O	..	..	..	..	..	..	37.53

answering to the formula  $\text{C}_{27}\text{H}_{22}\text{O}_{13}$ . Its reactions in solution are identical with those of quercetin as obtained from the decomposition of quercetrin. The crystalline form of the two products is different, the solubility in boiling alcohol of 60 per cent is not the same, and whilst quercetin does not crystallise in alcohol at 85 per cent, quercetagetin is deposited in the form of well-defined felted crystals.

Diatomic Phenol of Xylen.—Ch. Gundelach.—The author examines the iso-chlor-oxylen sulphite of potassa and its behaviour with potassa in fusion.

Volatilisation of Liquids in Gases.—W. Kirchman.—The author has observed that the evaporation of certain volatile bodies is retarded or hindered in an atmosphere of carbonic acid, whilst the volatilisation of other compounds is augmented. Camphor is scarcely volatilised at all in carbonic acid, as is also the case with bisulphide of carbon, chloroform, &c. Ether, methylic, ethylic, and amylic alcohols, and also water are more volatile in carbonic acid than in air. Dry carbonic acid is an excellent means for freeing essential oils from water.—*Archiv. fur Pharmacie*.

Industrial Treatment of Lepidolite for the Extraction of Lithium, Cæsium, and Rubidium.—H. Peterson.—Lepidolite contains very considerable quantities of alumina, which the author proposes to utilise. Its composition is:—

Alumina	..	..	..	..	..	28.54
Silica	..	..	..	..	..	50.39
Ferric oxide	..	..	..	..	..	0.73
Alkaline earths	..	..	..	..	..	1.52
Alkalies	..	..	..	..	..	16.00
Water	..	..	..	..	..	2 to 3

The mineral is melted in a reverberatory, suddenly chilled, and pulverised. It is then treated with an equal weight of monohydrated sulphuric acid in a vat lined with lead, and heated with a current of steam. The paste produced is then drawn off before it solidifies, and allowed to stand for twenty-four hours. An excess of water is then added, and the whole is then boiled, filtered at a boil in a leaden filter-press, or else allowed to settle and decanted without growing cold. The liquid is concentrated to 40° B. in leaden boilers heated by steam, and is then allowed to crystallise. On cooling all the rubidium and the cæsium are deposited as an alum along with a very

little potassium. The alums of cæsium and rubidium are separated by a series of crystallisations. The mother-liquors containing the potash alum and an excess of sulphate of alumina and free sulphuric acid are mixed with a cold concentrated solution of carbonate of potash (25 parts of dry carbonate to 100 of chilled lepidolite). The alum is deposited on cooling as a crystalline powder containing mere traces of iron. The mother-liquors of the alum, still acid, are diluted with water, treated with an excess of carbonate of potash to throw down the alumina, filtered, and evaporated to 35° B. Sulphate of potash and a portion of sulphate of soda crystallise out on cooling. The mother-liquors are again digested with powdered carbonate of soda to precipitate lithia. The small quantities of this base still remaining in solution are precipitated with phosphate of soda. The lithic phosphate thus obtained is melted with lime, and the lithia thus liberated is extracted in boiling water. The crude carbonate of lithia precipitated is re-dissolved in boiling water, and causticised with lime. The clear solution, concentrated to 40° B., is then again treated with pure carbonate of soda. Carbonate of lithia is then precipitated in a state of purity, and is washed first with a little water, then with alcohol, and finally dried.—*Dingl. Pol. Journ.*

Printing Cochineal Reds upon Woollen Tissues.—M. Kiemeier.—The author recommends an addition of acetate of soda to the colour to counteract the effect of the cochineal. He prefers the following mixture:—

Gum	..	..	..	..	14.0 kilos.
Water	..	..	..	..	15.0 „
Cochineal lake	..	..	..	..	17.5 „
Young fustic lake	..	..	..	..	2.2 „

The mixture is heated to 60°, and when the gum is dissolved there is further added—

Oxalic acid	..	..	..	1.00 kilo.
Pure salt of sorrel	..	..	..	1.75 „
Acetate of soda	..	..	..	2.25 kilos.

He adds that the addition of acetate of soda greatly improves the tone of steam yellows and oranges produced with young fustic. The benefit is still more signal in printing cottons with magenta.—*Dingl. Pol. Journ.*

*Biedermann's Central-Blatt für Agrikultur Chemie,*  
Heft 10, October, 1877.

Researches on the Cultivation of Moorlands.—Dr. A. Pagel and W. Th. Oswald.—Humate of lime can easily co-exist with free sulphuric acid in peaty soils, and when enclosed in resinous masses it may be totally ineffectual for the decomposition of injurious compounds of iron.

Transformation of the Phosphoric Acid of Mineral Phosphorites and Behaviour of Nitrogenous Compounds in Humous Soils.—Dr. F. Holdefleiss.—Natural humic compounds in the state in which they occur in arable soil and in peat-earth possess the property of decomposing crude phosphorites, if at all, to a very slight extent. The humoid products of the decomposition of farm-yard manure have a scarcely perceptible effect on the decomposition of natural phosphorites. The carbonic acid formed by the decomposition of the organic compounds is likewise incapable of accelerating in any practical degree the natural "weathering" of phosphorites. The organic acids in so-called "acid humus" are likewise incapable of attacking phosphorites. Inorganic salts, especially nitrates, have more effect upon phosphorites than the organic compounds just mentioned. Many peat-soils contain an appreciable amount of sulphuric acid, in consequence of which they render phosphorites soluble. All normal arable soils have the power of converting ammonia almost entirely into nitric acid. The presence of carbonate of lime promotes this transformation to such an extent that in six months far more than half the

absorbed ammonia is nitrified. When the organic substance of peat-earth consumes oxygen the formation of nitric acid may be delayed. Abundant application of potash-manures almost entirely checks the formation of nitric acid.

**Experiments on the Production of Plants.**—Prof. H. Hoffmann.—The author has been for twenty-two years engaged in experiments on the modification of plants by interference in their external vital conditions. He concludes that the cause of the evolution of new species lies, not, as Darwin believes, in outward influences, but in internal organic laws, whose nature is at present concealed.

**Defecation of Sugar-Cane with Magnesia.**—C. Bernard.—After neutralising with lime the juice is boiled up with magnesia in the proportion of 3 parts to 4000. It is then passed through Taylor's filter, and mixed with aqueous sulphurous acid till faintly acid; concentrated, crystallised, and dried in a hydro-extractor.

*Justus Liebig's Annalen der Chemie,*  
Band 189, Heft 1 and 2.

**Normal Primary Heptyl-Alcohol and Certain of its Derivatives.**—C. J. Cross.—The derivatives here described are heptyl-chloride, bromide, iodide, acetate, cœnanthylate, and ethyl-heptyl-ether.

**Contributions to a Knowledge of the Amidic Acids.**—Dr. F. Hofmeister.—The author gives a tabulated view of the behaviour of the amidic acids with reagents, describes the copper salts of leucin, asparagic acid, glutamic acid, and tyrosin; and finally treats of the solvent power of the amidic acids for cupric oxide in alkaline liquids.

**On Isodibutylene.**—A. Butlerow.—A prolonged memoir not capable of useful abstraction.

**Researches on Para-tolyl-phenyl-keton.**—W. Thörner.—The author examines the chlorine derivatives of this substance obtained by the action of phosphoric pentachloride or by that of free chlorine gas with the aid of heat, such as para-benzoyl-benzyl chloride, para-benzoyl-benzyl chloride, and para-benzoyl-benzo-trichloride. The second part of the paper treats of the isomeric pinacolines formed by the action of nascent hydrogen upon para-tolyl-phenyl-keton.

**Communications from the Chemical Laboratory of the Polytechnic School of Delft.**—These communications consist of a paper on "Products of the Decomposition of Phenol at a Red Heat," by Dr. J. G. Kramers; a memoir, by the same author, on the "Products of the Decomposition of Chlorbenzol at a Red Heat; and a third paper, by the same author, on the "Products of the Direct Chlorination of Diphenyl.

**Contributions to the History of the Naphthalin Derivatives.**—J. Stenhouse and C. E. Groves.—An account of nitroso- $\beta$ -naphthol, of mono-nitro- $\beta$ -naphthol, and of  $\beta$ -naphtho-quinon.

**On Acetylen Urea.**—Hugo Schiff.—This compound is obtained by the reaction of 1 part glyoxal and 2 parts of urea dissolved in 3 parts of water, with the addition of a few drops of hydrochloric acid. It contains 34.10 per cent of carbon and 4.40 of hydrogen, and may be represented by the formula  $C_4H_6N_4O_2$ .

**Peculiar Decomposition of Boric Ether.**—Hugo Schiff.—About 25 grms. of ethyl borate were placed in a well-stoppered bottle, the thick neck of which becoming accidentally cracked admitted very slowly watery vapour. After the lapse of about two years the edges of the crack were covered with crystalline boric acid, whilst the contents of the bottle were converted into a very hard, almost colourless, transparent, vitreous mass. Two similar portions of ethyl borate preserved in undamaged bottles had undergone no change.

**Action of Bromine upon Phloro-glucin.**—Rudolf Benedikt.—The author describes the preparation and

properties of phloro-bromine, and its behaviour with ammonia and alcohol.

**On Certain Derivatives of Uvitic Acid.**—Dr. Carl Böttger.—An account of nitro-uvitic acid, of  $\alpha$ -amido-uvitic acid, of  $\alpha$ -oxy-uvitic acid, of  $\beta$ -nitro-uvitic acid, of  $\beta$ -amido-uvitic, and  $\beta$ -oxy-uvitic acids.

**On Chloride of Iodine, Bromide of Iodine, Chloride of Bromine, and their Behaviour with Water.**—W. Bornemann.—Iodine takes up the more chlorine the more water is present. Bromide of iodine is soluble in water without any important decomposition. Chloride of bromine dissolves in water with a yellow colour; the solution retains the odour of chloride of bromine, bleaches litmus, and quickly loses the greatest part of the chloride of bromine on exposure to the air. The author confirms the statement of Schützenberger that pure chloride of iodine in a sealed tube remains liquid in the cold, but congeals on opening. In presence of  $ICl_3$  it crystallises, even in a sealed tube. On the distillation of  $ICl$  it is partially resolved into iodine and  $ICl_3$ , the same decomposition being also produced on prolonged exposure to the air. Bromide of iodine is a crystalline body of the colour of iodine; it is partially decomposed on distillation, and sublimes in frond-like aggregations of crystals. There does not exist a hydrated bromide of iodine of the formula  $BrI + 5H_2O$ , nor an analogous hydrated chloride of bromine.

**Communications from the Laboratory of the University of Halle.**—These consist of a paper on "Di-acetonamin and Vinyl-diacetonamin (Isotriacetonamin)," and a memoir on the "Action of Hydrocyanic Acid upon Hydrochlorate of Diacetonamin," both by W. Heintz.

Band 189, Heft 3.

**Researches on Optical Rotatory Power.**—H. Landolt.—(First Treatise: "On the Determination of the Specific Rotatory Power of Active Substances.") When we mention that this first part of the author's researches extends to nearly 100 pages, and comprises illustrations, extensive tables of the results of experiments, &c., it will be evident that we cannot offer anything like a fair abridgment. The author's principal results are:—(1.) The specific rotation of active bodies on increasing dilution with an indifferent liquid undergoes, not sudden, but continuously progressive modifications. Whether these consist of an increase or a decrease depends on the nature of the active body. (2.) From the rotatory power of a number of dilutions that of the pure substance may be calculated, though with a degree of certainty which varies in every case, and which is affected by—(a) The magnitude of the changes which the rotatory power undergoes by the admixture of the inactive liquids; (b) the manner in which these changes progress with an increasing proportion of the solvent, *i.e.*, whether they can be expressed by a straight line or by curves; (c) the concentration of the solutions employed. (3) On calculating the original specific rotation of any substance we obtain always the same value, no matter what indifferent liquid may have served as a solvent.

*Reimann's Färber Zeitung,*  
No. 42, 1877.

This issue contains nothing of general interest.

No. 43, 1877.

According to a sensational story now figuring in the German daily papers, certain wax candles fixed in a chandelier, which had been duly extinguished at the close of an entertainment in the Möckernstrasse, Berlin, contrived to re-ignite themselves in the middle of the night without human intervention. The candles in question, like all dangerous things, were green, and the colour is said to be due to an admixture of finely divided verdigris. The theory devised to account for the alleged phenomenon, and which we need scarcely say is *not* Dr. Reimann's, is that a fine coating of cupric or possibly of cuprous oxide had been deposited on the wick, which, in contact with

carbonaceous matter, absorbed oxygen, evolved heat, and thus re-lighted the candles.

For the hydrosulphurous acid of Schützenberger R. v. Wagner proposes the name hyposulphurous acid and the formula  $\text{HOSO}$ , whilst he gives to the compound  $\text{HOSO}_2\text{O}_2$ , formerly known as hyposulphurous acid, the name thio-sulphuric acid.

On purifying large quantities of purpurin, obtained from madder, it was found to be accompanied by a substance of the composition  $\text{C}_{30}\text{H}_8\text{O}_{12}$  distinct from all the constituents of madder hitherto known. At  $233^\circ$  it is resolved into purpuroxanthin and carbonic acid, and is hence named purpuroxanthino-carbonic acid.

*Les Mondes, Revue Hebdomadaire des Sciences,*  
No. 10, November 8, 1877.

**Means of Preventing the Explosion of Fire-damp in Coal Mines.**—M. Basin.—The author recommends ventilation with compressed air, watering the galleries (in dry mines), and the use of Bastie's toughened glass instead of wire-gauze for the cylinders of safety lamps. The tube which gives vent to the products of combustion will contain several superimposed layers of gauze.

No. 11, November 15th, 1877.

According to M. Fano neurosis of the eye has been successfully treated by the use of spectacles with yellow glasses.

M. L. Maiche has been led by a number of experiments to conclude that water is simply hydrogen+electricity, or oxygen—electricity. Or, in other terms, normal hydrogen, if electrified, becomes water, whilst normal oxygen, dis-electrified, also becomes water; hydrogen, oxygen, and water being one and the same thing with a different degree of electrification.

## MISCELLANEOUS.

**Butter Analysis.**—The prize offered by the Leipzig Pharmaceutical Association for a trustworthy method of butter analysis has been awarded to Otto Hehner, F.C.S., Public Analyst for the Isle of Wight, and Arthur Angell,

F.R.M.S., Public Analyst for the County of Hants. As one of the stipulations of the Association, namely, that the successful essay should become its exclusive property, could not be fulfilled by Messrs. Hehner and Angell's method, it having been published some years ago, and as the examiners, Professors Heintz, Knop, and Kohlmann, yet wished to express their appreciation of the method, they presented the authors with the sum of 150 marks. Six essays competed, two from Germany, two from England, one from Austria, and one from Italy.

**Owens College Chemical Society.**—It is with great pleasure that we call the attention of our readers to the formation of the above Society, which was inaugurated on the evening of Wednesday, the 21st inst. The members of the Society and several old students of the College were entertained by Prof. Roscoe in the College dining hall, after which they adjourned to the Chemical Theatre, where a lecture was delivered by Prof. Thorpe, F.R.S., on "Robert Boyle and the 'Sceptical Chemist.'" The Presidents of the Society are Profs. Roscoe and Schorlemmer, the Assistant Lecturers on Chemistry at the College acting as Vice-Presidents. Among the honorary members of the Society may be mentioned Prof. Thorpe, Prof. Dittmar, Prof. Atkinson, and Dr. C. R. A. Wright. The following are the subjects to be brought before the Society during the first session:—"Are the 'Elements' Elementary," by M. M. P. Muir, F.R.S.E.; "The Life and Work of Graham," P. P. Bedson, B.Sc.; "Alkali Manufacture," E. J. Bevan; "Berzelius," J. K. Crow, B.Sc.; "Crystallisation," H. Baker; "Liebig," C. F. Cross; "Valency," L. T. O'Shea; "The Chemical Industry of Japan," S. Sugiura. We trust that the example of the students of Owens College will be followed by the students of other provincial colleges.

## MEETINGS FOR THE WEEK.

SATURDAY, Dec. 1st.—Physical, 3. "The Telephone," Prof. Graham Bell.

MONDAY, 3rd.—Royal Institution, 2. (General Monthly Meeting). Society of Arts, 8. Cantor Lecture.

WEDNESDAY, 5th.—Society of Arts, 8.

THURSDAY, 6th.—Chemical, 8. "On Gallium," by Prof. Odling. "On the Constitution of the Terpenes and of Camphor," Dr. Armstrong. "On Potable Waters," Dr. Mills.

## COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

OCTOBER, 1877.

THE following are the returns of the Society of Medical Officers of Health:—

	Appearance in 2 foot Tube.	Ammonia.		Nitrogen as Ni- trates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	An- Sulphuric hydride.	Hardness on Clark's Scale.	
		Saline.	Organic.								Before Boiling.	After Boiling.
		Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
<i>Thames Water Companies.</i>												
Grand Junction .. ..	Slightly turbid	0.000	0.007	0.090	0.043	18.90	8.450	0.210	0.87	1.360	12.6	3.30
West Middlesex .. ..	Clear	0.000	0.008	0.090	0.043	19.00	8.560	0.430	0.86	1.300	13.7	3.30
Southwark and Vauxhall	Slightly turbid	0.002	0.010	0.097	0.058	19.50	8.730	0.320	0.87	1.260	13.7	3.70
Chelsea .. ..	Clear	0.002	0.009	0.165	0.054	18.10	7.840	0.430	0.87	1.360	13.2	3.70
Lambeth .. ..	Slightly turbid	0.000	0.009	0.135	0.047	20.40	9.070	0.430	0.87	1.300	14.8	3.30
<i>Other Companies.</i>												
Kent .. ..	Clear	0.000	0.004	0.285	0.010	26.10	10.800	0.720	1.37	2.400	20.0	5.10
New River .. ..	Clear	0.000	0.007	0.109	0.018	17.40	8.120	0.320	0.87	1.060	12.6	2.80
East London .. ..	Clear	0.000	0.007	0.099	0.040	19.60	8.560	0.360	1.01	1.460	14.3	3.30

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it.

C. MEYMOTT TIDY, M.B.

# THE CHEMICAL NEWS.

VOL. XXXVI. No. 941.

## DETECTION OF BISMUTH.

VON KOBELL'S TEST.

By W. M. HUTCHINGS.

THE mixture of equal parts of potassium iodide and sulphur recommended by Von Kobell for this excellent test has the great disadvantage of being very deliquescent; even if kept in closely-stoppered bottles it sooner or later becomes pasty, and indeed almost liquid, if the bottles are often opened for use. As it is a great advantage to be able to have such mixtures ready for use, and, where possible, to keep them in little wooden boxes in the portable blowpipe apparatus, I have tried replacing the potassium iodide by cuprous iodide, and have been glad to find that, in addition to the advantage of being non-deliquescent, the mixture so made is in other respects superior for use with the test.

Von Kobell's mixture has another disadvantage, viz., that it itself yields a copious *white* sublimate, the brilliant red sublimate obtained when it is used with a substance containing a good deal of bismuth being caused by the mixture of this white with the dark brownish red given by bismuth iodide alone. When very little bismuth is present and a good deal of the mixture is used, the white frequently overpowers the red almost completely, and when other metals are present which also give white or light-coloured sublimate it greatly assists in concealing the bismuth colour. This disadvantage is also got rid of by using cuprous iodide and sulphur.

The precipitated cuprous iodide is washed free from all trace of potassium salts, dried perfectly, and then ground up to an intimate mixture with an equal volume, or rather more, of flowers of sulphur. This proportion is the best; when less sulphur is used there is more or less white sublimate of cuprous iodide obtained, and also the formation of bismuth iodide is not as copious. For testing pyritous or other sulphide substances, less sulphur, or even none at all, would be required; but it is best to have a mixture which is equally applicable to *all* bismuth combinations. This mixture can be kept rammed tight into little wooden boxes, and is always ready for use. On aluminium plate I find it decidedly more delicate as a reagent than the potassium iodide mixture, using in each case 2 volumes of reagent to 1 volume of the powdered substance to be tested, intimately mixing to a paste and heating gently on a charcoal slip.

The merest trace of the dark brownish red bismuth iodide is very conspicuous on the clean aluminium. The plate should be made pretty hot by blowing the flame upon it some distance above the ledge before commencing to heat the test-mixture, in order to prevent the settling of any sublimate of *iodine*, or any condensation of moisture, which latter destroys the red bismuth sublimate. This precaution is particularly necessary when very little bismuth is present.

On ordinary charcoal or blackened porcelain support the dark-coloured bismuth iodide is not nearly so conspicuous as on aluminium, and does not show as well as the brighter red obtained by using potassium iodide. But a few tests with a substance containing very little bismuth will convince anybody that aluminium plate, with the cuprous iodide mixture, is very much preferable to charcoal and potassium iodide; and I do not think that anyone who has once used aluminium for blowpipe sublimate will ever again use charcoal or porcelain.

Substances containing mercury, when treated with the iodide mixture on aluminium plate, give a sublimate of

mercuric iodide, which is partly red and partly yellow, the relative quantities of the two colours varying much in sublimate from the same substance. The red is much lighter and brighter than that obtained from bismuth with the cuprous iodide mixture. It might possibly be taken for the bismuth sublimate mixed with that of lead; but as the number of minerals containing mercury is so limited, and the presence of that metal is so easily proved by other tests, no mistake is likely to arise from this cause.

The value of this test of Von Kobell's is very great; it deserves to rank as one of the best—in some cases the best—test for bismuth. As little as 0.2 or 0.1 per cent can be safely detected by it in many cases, and with great rapidity. In pyritous ores, which fuse to a regulus or in smelted regulus, a considerable amount of bismuth might be present and not be detected by the ordinary sublimate of bismuth oxide, which is frequently very difficult to obtain from such combinations. But a fraction of a per cent can be found by this test without resorting to the wet way.

Substances containing lead give a copious light yellow sublimate when heated with the iodide and sulphur mixture, and when lead is present beyond certain limits this yellow overpowers the bismuth reaction. According to Cornwall (CHEMICAL NEWS, vol. xxvi., p. 150), when lead oxide was mixed with 5 per cent bismuth oxide and tested on charcoal by Von Kobell's mixture, the bismuth could only just be detected, and not with distinctness. But I find that when lead oxide containing only 1 per cent bismuth oxide is tested with the cuprous iodide mixture on aluminium plate a very fine brownish red sublimate is always obtained by heating very gently and observing after a few seconds. Later on the yellow covers this up; but the bismuth iodide always comes off first, and can be seen if observed in time. In all cases sublimate must be allowed to get quite cold before judging them; lead iodide is reddish when hot, but pure light yellow cold.

Cornwall's tests in open glass tubes (CHEMICAL NEWS, vol. xxvi., p. 150) which will detect bismuth when present in such small quantity with lead and antimony that the above method fails, can be better applied with the cuprous iodide mixture than with potassium iodide, and so much sulphur as he recommends (5 volumes) does not require to be added.

These mixtures are also very useful for detecting lead in cases where the ordinary sublimate of the oxide cannot be obtained.

Laboratory, Wallasey Ore Works,  
Birkenhead, November 22, 1877.

## APPLICATION OF ORGANIC ACIDS TO THE EXAMINATION OF MINERALS.\*

By H. CARRINGTON BOLTON, Ph.D.

1. THE organic acids have long been used in various operations of chemical analysis, but their direct application to the decomposition of minerals, with a view to the determination of the latter, appears to have been overlooked. Acetic acid finds frequent employment in quantitative analysis; tartaric and citric acids are used to hold ferric and aluminic hydrates in solution in the presence of alkalis, to dissolve antimonite oxide in mineral analysis and in blowpipe tube reactions,† and in the preparation of Fehling's copper solution; ammonium citrate is used to dissolve so-called "reverted" calcium phosphate, and to separate lead sulphate from the sulphates of the alkaline earths; oxalic acid is used to dissolve sulphide of tin in the separation of this metal from antimony,‡ in volumetric analysis, in the determination of the metals

\* Read before the New York Academy and Sciences, April 30, 1877

† Prof. E. J. Chapman, *Canadian Journal*, Sept., 1865, p. 348.

‡ Prof. F. W. Clark, *American Journal of Science*, [2], xlix., 48.

of the magnesium group,\* in the valuation of manganese ores, and in many other process.

The behaviour of minerals with the organic acids named has been only casually studied, and in but few instances; T. Sterry Hunt,† following Karsten, has made use of acetic acid in the proximate analysis of mixtures of calcite, dolomite, and magnesite, and in the separation of limestone and serpentine;‡ J. Lawrence Smith§ has remarked the solubility of anglesite in ammonium citrate; calamine is sometimes distinguished from willemite by its gelatinising with acetic acid;|| and mineralogists often resort to the comparatively weak acetic acid for the purpose of "cleaning up" minerals associated with the easily soluble calcite. So far as we can learn, no systematic examination of the action of organic acids on minerals has previously been made; yet the field proves to be wide and fertile.

During a mineralogical excursion in the summer of 1876, among the rugged mountains of western North Carolina, the impracticability of transporting liquid mineral acids suggested to the writer an examination of the behaviour of minerals with solutions of citric and tartaric acid, which are capable of being carried in the solid state. Subsequently a few preliminary trials established the fact that our preconceived notions of the weakness of organic acids as respects minerals were erroneous, and led to the investigation recorded in the following pages.

It became necessary at the very outset to collect a considerable number of minerals in a state of great purity and of normal physical condition: our own small collec-

tion supplied these in part, but we would have been embarrassed in this research without the kind assistance of Prof. Thomas Egleston, who generously placed the rich treasures of the School of Mines' mineralogical collection at our disposal, and to whom we tender our sincere thanks.

Since the hardness, coherence, and solubility of minerals vary greatly in different specimens of a single species, the behaviour of minerals with acids, whether inorganic or organic, depends in large measure upon the condition of the particular sample under examination. An absolutely thorough investigation, therefore, would embrace the reactions of several specimens of each mineral; as desirable as this would seem to be, it was found that on the whole so laborious an undertaking was superfluous, and for two reasons; first, the decomposing action of the acids on different samples of the same species differs in degree and not in kind; and, secondly, the behaviour of different species nearly related is so similar that the observations made on each serve to mutually control.

2. The following list contains the names of the minerals which were submitted to the action of organic acids, their formulæ as given by Prof. Dana, the condition of the specimens, and the locality of each so far as could be ascertained. Where two or more specimens of a single species are named, they are numbered for convenience of reference in subsequent pages.

Within the groups I., Carbonates; II., Sulphides; III., Oxides; IV., Sundries; V., Silicates, the minerals are given in the order, and with the formulas, which they have in "Dana's System of Mineralogy."

#### I. CARBONATES.

Mineral.	Formula.	Description.	Locality.
Calcite (1) .....	$\dot{\text{C}}\text{a}\ddot{\text{C}}$	fine-grained marble ....	Italy.
„ (2) .....		transparent crystals....	Bergen, N.J.
Dolomite (1) .....	$\dot{\text{C}}\text{a}\ddot{\text{C}} + \dot{\text{M}}\text{g}\ddot{\text{C}}$	coarse crystalline.....	Westchester Co., N.Y.
„ (2) .....		{ fine granular, with } { flakes of graphite }	Amity, N.Y.
Gurhofite .....	$2\dot{\text{C}}\text{a}\ddot{\text{C}} + \dot{\text{M}}\text{g}\ddot{\text{C}}$	massive, subtranslucent	Montville, N.J.
Ankerite .....	$\dot{\text{C}}\text{a}\ddot{\text{C}} + (\dot{\text{M}}\text{g}\dot{\text{F}}\text{e}\dot{\text{M}}\text{n})\ddot{\text{C}}$	crystalline .....	Nova Scotia.
Magnesite (1) ....	$\dot{\text{M}}\text{g}\ddot{\text{C}}$	massive .....	Westchester, Pa.
„ (2) ....		compact .....	Piedmont.
Siderite (1) .....	$\dot{\text{F}}\text{e}\ddot{\text{C}}$	massive .....	Roxbury, Conn.
„ (2) .....		massive .....	Dauphiny, France.
Rhodochrosite ....	$\dot{\text{M}}\text{n}\ddot{\text{C}}$	massive, pure .....	Austin, Nev.
Smithsonite .....	$\dot{\text{Z}}\text{n}\ddot{\text{C}}$	earthy, massive.....	Sterling, N.J.
Witherite .....	$\dot{\text{B}}\text{a}\ddot{\text{C}}$	granular, massive.....	England.
Strontianite .....	$\dot{\text{S}}\text{r}\ddot{\text{C}}$	granular .....	Westphalia.
Cerussite .....	$\dot{\text{P}}\text{b}\ddot{\text{C}}$	crystalline .....	Phoenixville, Pa.
Barytocalcite ....	$\dot{\text{B}}\text{a}\ddot{\text{C}} + \dot{\text{C}}\text{a}\ddot{\text{C}}$	massive and crystalline	Alston Moor, England.
Malachite .....	$\dot{\text{C}}\text{u}\ddot{\text{C}} + \dot{\text{C}}\text{u}\dot{\text{H}}$	compact .....	Russia.
Azurite .....	$2\dot{\text{C}}\text{u}\ddot{\text{C}} + \dot{\text{C}}\text{u}\dot{\text{H}}$	massive, earthy .....	Germany.

(To be continued).

\* W. Goold Levison, *American Journal of Science*, [2], 1, 240.

† *American Journal of Science*, [2], xxviii., 180, and xlii., 64.

*Geol. Canada*, 1863, 609.

§ *American Journal of Science*, [2], xx., 244.

|| "Dana's System Min.," 5th edition, p. 408.

# A STUDY OF CYANOGEN COMPOUNDS.

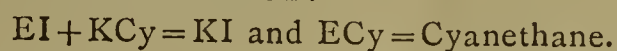
By SAMUEL E. PHILLIPS.

(Concluded from p 240.)

OUR present knowledge of cyanides seems to justify a threefold division:—

1. Of simple cyanides, or those conforming to the ordinary types of mineral chemistry.
2. Nitrile-cyanides; an isomeric group of ammonias, where we find the terms "methyl-cyanide" or "aceto-nitrile,"  $(C_4H_7)H_2N$ ; ethyl-cyanide or propio-nitrile,  $(C_6H_5)H_2N$ , &c. These are 2 vol. ammonias, and have the corresponding ammonium forms.
3. Iso-cyanides; another isomeric group of ammonias, which also have their corresponding ammonium forms.

A methyl-cyanide of this class would probably be  $C_2MeN$ , an ethyl-cyanide  $C_2EN$ . Hence they are called "carbamines;" but as this point of view is new it may be well to give a further elucidation:—



This is a mixture of two liquid substances of like composition and different properties.

Cyanides or Nitriles.	Cyanides or Iso-Cyanides.
$ECy = C_6H_5, H_2N$ ; B.P. $88.5^\circ$ .	$ECy = C_2EN$ ; B.P. $78^\circ$ .
Propionamide $C_6H_5O_2, H_2N - 2HO =$ all $(C_6H_5), H_2N$ .	$EH_2N + C_2H_5, Cl_3 +$ $+ 3KO.HO =$ all $C_2EN$ .
$C_6H_5, H_2N + 2HO =$ = propionamide.	$C_2EN + 2HO =$ = $(C_2H_5O_2)HEN$ .
$C_6H_5, H_2N + 4HO =$ = propionic acid and $H_3N$ .	$C_2EN + 4HO =$ = formic acid and $EH_2N$ .
Nitriles are considered to be $C_{IV} \left\{ \begin{array}{l} (C_2H_5) \\ N_{III} \end{array} \right.$	Carbamines are considered $N_{III} \left\{ \begin{array}{l} (C_2H_5) \\ C_{II} \end{array} \right.$
Non-poisonous.	Poisonous, purgent, nauseous, greater chemical activity, combine with HCl, &c., and oxy-acids, and yield cyanurates — carbimides.

It is amusing to see the cuprammonium notations,  $(NH_3cu)$ , where cu means an equivalent  $= (31.75)$  instead of an atom  $Cu = 63$ , nor do I accept the apologetic explanation. "The notation cu is used, for an equivalent of copper, to simplify the formula." Away with our notions of simplicity that imply untruth! If equivalents are only imaginary conveniences, and diatomic atoms are the real thing, then by all means let us have them, however ugly or apparently confusing.

The chloro-cyanic acid,  $Cy_3Cl_2H$ , and chloro-cyanamide,  $Cy_3(NH_2)_2Cl$ , are comparatively unimportant substitutional varieties,—

The former possibly of D type,  $C_6Cl_3N_3$ ,  
Chloro-cyanic acid =  $C_6Cl_2HN_3$   
Of which C gives  $C_6H_3N_3$

The ammeline of the books and that of Hofmann is undoubtedly an amide containing O; but the ammeline of S. Lupton may mean something else, and all depends on what is really intended, or should be intended by his outside (OH), an important point greatly confused by modern types. If it means that this (OH) is that of the hydrate or amine, then it might appear as a new and legitimate type of a new body, and the word "ammeline" would be a wrong designation.

It would have the elements of  $Cy_3H_3N_2$ .

The chloride,  $Cy_3H_4N_2Cl$  = chloro-cyanamide.

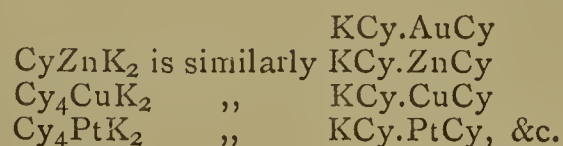
The hydrate,  $Cy_3H_4N_2O.HO$  = ammeline?

But the notation  $Cy_3(NH_2)_2$  would be inadmissible, as containing one H too many.

The inference that because a silver dicyanuramide has been obtained in a hydrated form therefore all others should be doubled is curiously invalid. Hofmann obtained a similar condensation, but omitted any such extravagant inference; we have purposely referred to one, a dimelanuric acid. Besides, it is notorious that such are common in organic chemistry.

*Tetra-cyanides*,  $(Cy_4)^{IV}$ .—This group, like No. 3, dwindles to almost nothing upon investigation. The cyanide of gold is undoubtedly a normal cyan-aurate,  $KCy.AuCy_3$ . The others are doubled proto-cyanides.

$Cy_4Ag_2K_2$  is given as  $Cy_2AgK$  in the dicyanides, and is plainly—



Azulmic acid may be isomeric or identical with mycomelic acid; but why two acid terms for one indifferent amide? What that amide is, and what the character of its genesis, I hope to have shown (CHEM. NEWS, vol. xxxii., p. 209).

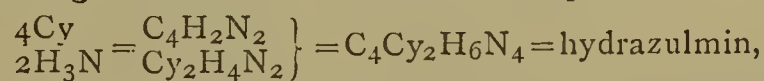
Mycomelic acid = (1.)  $(C_4H_7O_4)Cy_2H_3N_2$  = azulmic acid.

(1.)  $+ H_3N - 2HO =$  (2.)  $(C_4H_7O_2)Cy_2H_2(NH_2)N_2 =$   
= hydrazulmoxin.

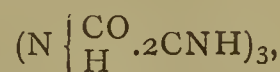
(2.)  $+ H_3N - 2HO =$  (3.)  $(C_4H_7)Cy_2H(NH_2)_2N_2 =$   
= hydrazulmin.

These bodies are exceedingly confused, and very unimportant for the main purposes of classification, and further knowledge will add to their isomeric and other variations.

Azulmin, or hydrazulmin, as directly produced by cyanogen and ammonia, might well suggest a different notation to that we have given, and from this point of view the following would be a more feasible interpretation:—



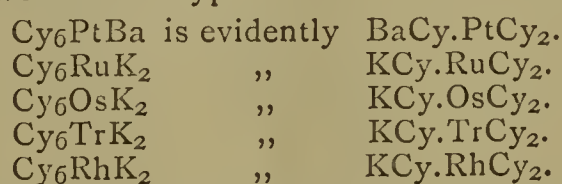
but the transition to azulmic acid herefrom is not easily seen. It is probably in a somewhat similar way that Gautier derives his azulmic acid, from the oxidation of  $3HCy$ . It has the elements of  $C_6H_3O_2N_3$ , or double. Gautier notates it—



or we may suppose  $3HCy + O_2 = CO_2C_4H_3N_3$ ; then anticipating another connection, we have hydrazulmoxin by simple oxidation, giving azoulmoxin or azo-azulmoxin, which has the elements of  $(CO)_4Cy_2H_3N_3$ .

*Penta-cyanides*,  $(Cy_5)^V$ .

*Hexa-cyanides*,  $(Cy_6)^{VI}$ .—Here we have some cyanosalts of a well known type.



These are well confirmed with oxy, chloro, or sulpho types. The ferric cyanide  $Cy_6Fe_2.3H_2O$  is evidently  $Fe_2Cy_3.3HO$ , and is more normal with  $3HCy$ .

The lead cyanurate is plainly  $CO_6Pb_3N_3$

The silver " "  $CO_6Ag_3N_3$ , or its di.

Ammeline is given as  $Cy_6(NH_2)_3(OH)_3$ , but wherefore? and why these hydroxyls and amides?

2 ammeline,  $(CO_2)Cy_2H_5N_3 + 2HO =$  ammeline =  
 $(CO_6)Cy_3H_9N_6$  and  $H_3N$ .

Or we may say cyanuric acid + melamine = ammeline. Also, ammeline  $- 2H_3N =$  cyameluric acid,  $(CO_6)Cy_3H_3N_4$ .

2 melamine  $- H_3N =$  melain  $Cy_6H_9N_5$ .

*Hepta-cyanides*, "wanting."

*Octa-cyanides*,  $(Cy_8)^{VIII}$ .—Here are only three puzzles. 'The magnetic cyanide of M. Pelouze' is evidently

$\text{Fe}_3\text{Cy}_4$ , and corresponds to the magnetic oxide of iron,  $\text{Fe}_3\text{O}_4$ ; and in Snieder's new sulpho-salts it becomes an established type,  $2\text{KS}.\text{Fe}_3\text{S}_4$ , with many varieties.

The potassio-cuprous cyanide may be  $3\text{KCy}.\text{CuCy}$ , but such protoïdes mostly have 2 atoms of base, and in many cases only one.

Azoulmoxin we have referred to.

*Ennea-cyanides*,  $(\text{Cy}_9)^{\text{IX}}$ .—Here are only two puzzles.  $\text{Cy}_9\text{N}(\text{NH})_3 + \text{mellon}$ ! But why  $3(\text{NH})$ , or why N by itself?

3 melamine  $- 5\text{H}_3\text{N} =$  the elements of mellon,  $\text{Cy}_9\text{H}_3\text{N}_4$ .

Gautier's azulmic acid we have referred to.

*Deka-cyanides*,  $(\text{Cy}_{10})^{\text{X}}$ .—The potassium platina cyanide,  $\text{Cy}_{10}\text{Pt}_2\text{K}_4$ , is evidently  $2\text{KCy}.\text{Pt}_2\text{Cy}_3$ , a type somewhat unusual with platinum (only one given), but very common with iron and other elements, which are mostly tribasic. The corresponding sulpho-salt may have one or two atoms of base.

*Hendekacyanides*,  $(\text{Cy}_{11})^{\text{XI}}$ .—"Wanting."

*Dodeka-cyanides*,  $(\text{Cy}_{12})^{\text{XII}}$ .—These comprehend two separate and well-known groups, the ferro- and ferri-cyanides. As the former contain 3 equivalents of Cy and the latter 6, two multiplicands of 4 and 2, with a characteristic disregard of chemical evidence, make one group with one type of twelve-fold atomicity!

#### The Ferro-cyanides.

$\text{Cy}_{12}\text{Fe}_2\text{H}_8$	is undoubtedly	$2\text{HCy}.\text{FeCy}$
$\text{Cy}_{12}\text{Fe}_2\text{K}_8$	"	$2\text{KCy}.\text{FeCy}$
$\text{Cy}_{12}\text{Fe}_2\text{Ca}_4.\text{H}_2\text{O}$	"	$2\text{CaCy}.\text{FeCy}$
		$2\text{KCy}.\text{NiCy}$

These are normal types which may be extended indefinitely; there are only three abnormal or inverted types—

$\text{Cy}_{12}\text{Fe}_2\text{Fe}_2\text{K}_4$	$\text{KCy}.\text{2FeCy}$
$\text{Cy}_{12}\text{Fe}_2\text{Sr}_2\text{K}_4.3\text{H}_2\text{O}$	$\text{KCy}.\text{FeCy}$
	$\text{SrCy}$
$\text{Cy}_{12}\text{Fe}_2\text{Fe}_2(\text{NH}_3\text{fe})_4$	$\text{ACy}.\text{2FeCy}$
	$\bar{\text{A}} = \text{H}_3\text{FeNCy}$

These cyanides crystallise with various amounts of HO, and analysed at any given desiccation the inferences of di or tetra compounds may be extremely unsatisfactory.

#### The Ferri-cyanides.

$\text{Cy}_{12}\text{Fe}_2\text{H}_6$	is undoubtedly	$3\text{HCy}.\text{Fe}_2\text{Cy}_3$
$\text{Cy}_{12}\text{Fe}_2\text{K}_6$	"	$3\text{KCy}.\text{Fe}_2\text{Cy}_3$
$\text{Cy}_{12}\text{Fe}_2\text{Ca}_3$	"	$3\text{CaCy}.\text{Fe}_2\text{Cy}_3$
$\text{Cy}_{12}\text{Co}_2\text{K}_6$	"	$3\text{KCy}.\text{Co}_2\text{Cy}_3$
$\text{Cy}_{12}\text{Mn}_2\text{K}_6$	"	$3\text{KCy}.\text{Mn}_2\text{Cy}_3$
$\text{Cy}_{12}\text{Cr}_2\text{K}_6$	"	$3\text{KCy}.\text{Cr}_2\text{Cy}_3$

These familiar salts are well known in corresponding oxy, chloro, sulpho, and other forms, with no attempt to make either O or Cl to possess a dodeka atomicity!

If the ferro- and ferri-cyanides, the prussiates of potash of commerce containing no potash, were the only forms of cyan-ferri acid we might eclectically tolerate the common designations, but as there are other types, and the group is greatly enlarged by oxy, chloro, sulpho, and other analogues, it is important to understand the conditions involved in a rational and simple nomenclature; and if we always bear in mind that the prefix oxy is understood without expression in oxy-salts, the wide extension of this old principle is an easy matter, according to which we have—

Sulphates..	..	..	..	$\text{KO}.\text{SO}_3$
Aurates ..	..	..	..	$\text{KO}.\text{AuO}_3$
Chlo-aurates ..	..	..	..	$\text{KCl}.\text{AuCl}_3$
Cyano-aurates ..	..	..	..	$\text{KCy}.\text{AuCy}_3$ , &c.

We might well and safely trust a Lindley or a Hooker to a greenhouse study of Hybrid Botany; but modern chemists luxuriate in such regions without any logical regard or discriminative appreciation of the normal and abnormal: we therefore conclude with two or three complexities which might have adorned the above list of cyanogen atomicities.

M. Claus has discovered some melamine derivatives:—

Melamine	+ 2HS	—	$\text{H}_3\text{N} = (\text{CS})_2\text{Cy}_2\text{H}_5\text{N}_3$	sulph-ammelin
2	"	"	$2\text{H}_3\text{N} = (\text{CS})_2\text{Cy}_5\text{H}_8\text{N}_5$	"
3	"	"	$3\text{H}_3\text{N} = (\text{CS})_2\text{Cy}_8\text{H}_{11}\text{N}_7$	"

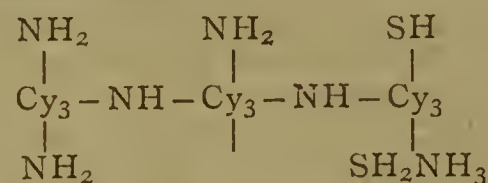
And from another physicist we have a parallel study of so-called "prussamic acids," the first term being identical with the second of M. Claus; and does it thence follow that sulph-ammeline is a "mono-thio-prussamic acid"?

2 melamine + 2HS  $- 2\text{H}_3\text{N} =$  mono-thio-diprussamic acid,  
 $(\text{CS})_2\text{Cy}_5\text{H}_8\text{N}_5$ .

2 melamine = 4HS  $- 3\text{H}_3\text{N} =$  di-thio-diprussamic acid,—  
 $(\text{CS})_4\text{Cy}_4\text{H}_7\text{N}_5$ .

3 melamine + 4HS  $- 3\text{H}_3\text{N} =$  di-thio-triprussamic acid,—  
 $(\text{CS})_4\text{Cy}_7\text{H}_{13}\text{N}_8$ .

The names and notations are a prodigious mistake, and out of respect to the printer we only give the constitutional picture of the latter amide:—



Why one of these hooks should be suspended *minus* in mid air, and another should have two radicals or groups dangling at its end, involves an order of symmetry beyond common comprehension. Mr. Sidney Lupton may well claim it for one of his very slender groups with an ennea-cyanide atomicity; but, on the contrary, we claim it as having 7 equivalents of cyanogen instead of 9; and although my projections are only mooted as *à priori* probabilities, yet I do contend that the function +2HO or HS, under the circumstances, is patent to a popular and amateur understanding, although it may be utterly ignored by our great masters in this school of thought and endeavour.

## PROCEEDINGS OF SOCIETIES.

### PHYSICAL SOCIETY.

December 1, 1877.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

PROF. GRAHAM BELL exhibited and described the Telephone before a crowded meeting of the Society, prefacing his account of the apparatus now so well known by a very complete historical sketch of the progress of electric telephony. The first experiments referred to were those of Prof. Page, who in 1837 was studying the relation of electricity to magnetism, and found that if a coil of wire, traversed by a current, surrounds an iron rod, a sound like a pistol shot proceeds from this latter whenever the current is made or broken. He was followed by De la Rive, Poggendorff, Reiss, and others; but Reiss was the first to employ the human voice in his experiments. After pointing out that in transmitting sounds by electrical means the initial sounds themselves are in no sense transmitted, but are only employed to generate currents which reproduce similar sounds, Prof. Bell proceeded to examine the phenomena which take place when sounds are transmitted through the air. It is, of course, not the motion of the vocal organs themselves that is received in the ear, but that of the air set in motion by their means, and all peculiarities in the sound must be peculiarities in the motion of that air. If the rapidity of motion varies it occasions a variation in the pitch, and the loudness is changed by changing the amplitude. The *shape* of the vibration produces timbre. If, by moving the air in certain specified ways, certain vowel sounds are given out, then those same

sounds will be emitted if an identical movement be occasioned by any mechanical means whatever; and Prof. Bell has found that such a motion may really be given to the air in various ways. Three classes of electrical currents have been employed for transmitting sounds to a distance, and these he denominates Intermittent, Pulsatory, and Undulatory. The first form is obtained when a current passes for a brief interval, is then followed by an interval during which no current passes, and this by a current of the same or opposite sign. In the second class a current is continually passing, but its intensity increases and decreases instantaneously; and finally, in the third class, this variation takes place gradually, and may therefore be represented by a sinuous line. In his experiments on the nature of the movement of the air Prof. Bell employed a human ear, a straw style attached to the incus, recording the movement communicated to it on a moving sheet of smoked glass. A very interesting series of curves produced by this means was shown upon the screen, and he explained how his experiments in this direction led him to the present form of telephone. Since the very small membrane of the ear was capable of setting in motion comparatively large bones, it seemed probable that it could cause a light piece of iron to vibrate. In the earlier form of apparatus a piece of steel spring was therefore attached to a stretched membrane of gold-beater's skin, and placed in front of the pole of the magnet; but he found on increasing the area of metal that the action of the instrument was improved, and thus was led to do away with the membrane itself. Another branch of the investigation referred to the strength of the magnet employed, and this was modified by varying the strength of current. The battery was gradually reduced from fifty cells to none at all, and still the effects were observed, but in a much less marked degree: the action was in this latter case doubtless due to residual magnetism,—hence, in the present form of apparatus, a permanent magnet is employed. Lastly, the effect of varying the dimensions of the coil of wire was studied, when it was found that the sounds became louder as its length was diminished: a certain length was, however, ultimately reached, beyond which no improvement was effected, and it was found to be only necessary to enclose one end of the magnet in the coil of wire. A number of diagrams were projected on to the screen, which showed the various forms the apparatus has taken from the time of Page to the present day. An air sung in a distant part of the building was distinctly heard in the room by the aid of an improved form of Reiss's telephone, lent by Prof. Barrett, and made by Mr. Yates, of Dublin. Prof. Bell, Prof. Foster, and Dr. Gladstone then carried on a conversation with a gentleman at a distance, and utterances were shown to be audible when the transmitting instrument was held about a foot from the mouth.

A discussion then followed, in which Mr. De la Rue, Dr. Gladstone, Profs. Foster, Guthrie, Atkinson, and others took part.

In replying to the various questions Prof. BELL stated that his attempts to determine the amplitude of the vibrations had not been successful, and he is coming to the conclusion that the movement must be molecular. Very distinct sounds are emitted when a considerable mass of iron is employed; and further, if the iron be glued to a piece of wood an inch thick, and this be interposed between it and the magnet, the action still continues. Conversation has been carried on through a distance of 258 miles, but a resistance of 60,000 ohms has been interposed without preventing the action. There is a very marked difference in the manner in which letters are reproduced by the telephone. Vowel sounds are more acceptable than consonants, and, as a rule, those letters are best transmitted which involve a large oral aperture in their utterance. Finally, he finds that high sounds are produced more fully than low ones; but this question has not yet received sufficient attention.

UNIVERSITY COLLEGE CHEMICAL AND  
PHYSICAL SOCIETY.

Prof. G. CAREY FOSTER, F.R.S., in the Chair.

At a meeting of this Society held on November 29th a paper was read on "*The Telephone*," by Mr. H. FORSTER MORLEY, M.A., B.Sc. (Vice-President). An exceedingly large audience had assembled to hear the reading of this paper, Profs. Remedy, Croom-Robertson, Ringer, Maudsley, and Mr. Serjeant Simon, M.P., being among the number.

Mr. MORLEY commenced his paper by pointing out the circumstances which led to Prof. Bell turning his attention to the subject of Telephony; and after reminding his hearers of a few points connected with the theories of Sound and Electricity necessary for the elucidation of the subject in hand, he proceeded to consider the first forms of telephones, devoting especial attention to the description and explanation of the experiments of Helmholtz. He then proceeded to sketch the steps by which Prof. Bell had been led up to the present form of telephone, the first instrument capable of transmitting articulate sounds in a satisfactory manner. Mr. Morley went on to give an elaborate and detailed description of the apparatus in its present form, showing its construction, explaining the theory of its action, and calling special attention to the fact that the satisfactory working of Prof. Bell's instrument was due to approximately undulatory currents being produced in the wire, whereas in previous instruments only intermittent or pulsatory currents had been obtained.

Several very successful experiments were then made; the sound of the telephonic organ, amongst other things, being very distinctly heard in every part of the room by means of the ordinary small telephones.

The CHAIRMAN, in moving that the thanks of the meeting be accorded to Mr. Morley for his lecture, remarked on the able and careful way in which his paper was written, and then proceeded to congratulate the Society on its present prosperous condition, and to wish it success in the future.

The thanks of the meeting having been heartily given to Mr. Morley, a vote of thanks to Prof. Graham Bell for his kindness in lending the Society his instruments was moved by Mr. Chas. Cassal (the Secretary), seconded by Mr. Plimpton (Treasurer), and carried by acclamation, as was also a vote of thanks to Prof. Foster, which was moved by Dr. O. J. Lodge (President), and seconded by Mr. Wright.

The CHAIRMAN having briefly returned thanks, the proceedings terminated.

DEUTSCHE CHEMISCHE GESELLSCHAFT,  
BERLIN.

November 12, 1877.

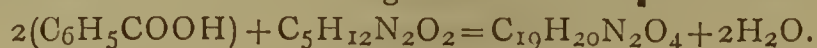
Prof. A. W. HOFMANN, F.R.S., Vice-President, in the Chair.

DR. C. A. MARTIUS presented a call, signed by thirty leading firms, summoning all interested in forming a Society of German chemical manufacturers to an organisation meeting at Frankfort, on November 25th.

Prof. Buff (of Giessen), Prof. G. Kirchhoff (of Berlin), and Prof. G. Stenhouse (of London) were proposed as honorary members of the Society. The chemical library of the late Prof. Oppenheim has been bequeathed to the Society. The following communications were presented:—

C. BÖTTINGER, "*Acetylen Urea*." The author obtains, by the action of CNH on glyoxal and urea, a body,  $C_4H_6N_4O_2$ , corresponding to the acetylen-carbamide lately described by Schiff in the *Annalen*.

M. JAFFE, "Action of Benzoic Acid in the Organisms of Birds." The author finds, in the excrement of birds which have been fed on benzoic acid, a new acid—ornithuric acid—crystallising in colourless needles, yielding amorphous salts only, and possessing the formula  $C_{19}H_{20}N_2O_4$ . By treatment with HCl the acid is decomposed into benzoic acid (2 mols.), and a new base,  $C_{15}H_{12}N_2O_2$ , which forms a double row of crystalline salts with acids. The base is considered as the first diamido-derivative in the fatty series, and ornithuric acid results from its union with benzoic acid in the organism of birds as follows:—



H. MEYER and M. JAFFE confirm the experiments of Cech on "The Formation of Uric Acid in the Organisms of Birds" (CHEM. NEWS, xxxvi., 39), showing that urea, when fed to fowls, is completely changed into uric acid.

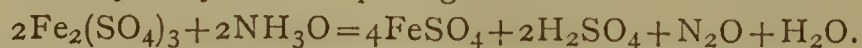
R. NIETZKI, "Preparation of Quinons and Hydroquinons." At present quinon costs about the same as metallic gold. The author has formed a method by which it can easily be prepared, at about twelve times the cost of aniline, by simply oxidising the latter. The process consists in dissolving aniline in dilute  $H_2SO_4$ , adding slowly a cold solution of bichromate of potash, passing a stream of  $SO_2$  through the product of the reaction, and extraction with ether. According to the amount of bichromate used, hydroquinon or quinon is formed—18 per cent of the former and 9 per cent of the latter. With equal ease hydro-tolu-quinon is obtained from ortho-toluidin. For the crystallisation of the two hydroquinons crude toluen can be used to good advantage.

S. HOOGEWERFF and W. A. VAN DORP, "Oxidation of Compounds containing N by means of  $KMnO_4$ ." It is ascertained, in harmony with the experiments of Wanklyn and Chapman, that in several compounds one-half of the N present is changed into  $NH_3$ . Aniline yields 50 per cent of its N as  $NH_3$ , 33 per cent as ozo-benzene, with small quantities of nitrates and nitrites, requiring nine times its weight of  $KMnO_4$  for complete oxidation. The author's experiments show likewise that  $NH_3$  is not oxidised by  $KMnO_4$ .

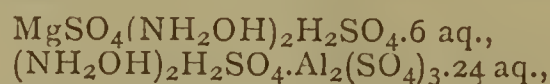
W. MEYERINGH, "Volumetric Determination of Hydroxylamin, and new Double Salts of this Compound." Several methods are described. With iodine solution exactly 2 atoms of I are required for the oxidation of 1 mol. hydroxylamin, if the HI thereby formed is at once neutralised with MgO:—



Trituration with a permanganate solution, after oxidation with  $Fe_2(SO_4)_3$  at  $90^\circ$ , gives equally reliable results; 1 mol. hydroxylamin requiring 1 atom O:—



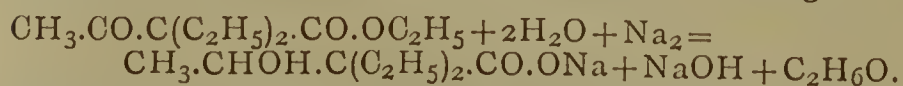
Fehling's solution can also be used, 1 mol. hydroxylamin being oxidised regularly by 2 mols. CuO in alkaline solution. Chromic acid is not practicable. Among new salts described are—



and the corresponding Cr and Fe salts, all of which crystallise in handsome octahedra.

H. BECKURTS and R. OTTO prepare "Monochlor-acrylic Acid" by adding  $Ag_2CO_3$  to  $\alpha$ -dichloro-propionic acid, and distilling the product. The acid  $CH_2.CCl.COOH$  thus obtained is an oily liquid, soluble in all the ordinary solvents, volatile at low temperatures, and boiling at  $176^\circ$ . A number of salts are described. By heating with HCl the acid is changed into  $\alpha$ -dichloro-propionic acid; and by treatment with nascent H, propionic acid results.

H. SCHNAPP prepares "Diethyl- $\beta$ -oxybutyric Acid" by treating diethyl-aceto-acetic ether with sodium-amalgam—



The acid is a syrupy liquid, soluble with difficulty in  $H_2O$ , and yielding, on heating, ethylic aldehyd and diethyl-

acetic acid,  $CH_3.CHO + CH(C_2H_5)_2.COOH$ . The latter boils at  $195^\circ$ , is lighter than water, and gives an ethylic ether boiling at  $151^\circ$ .

A. RÜCKER obtains "Methyl-crotonic Acid,"  $C_5H_8O_2$ , by the action of HI on methyl-aceto-acetic ether, and, by treatment of the same compound with  $PCl_5$ , chloromethyl-crotonic acid,  $C_5H_7ClO_2$ , melting at  $69^\circ$ , and volatilising slightly higher.

E. J. HALLOCK describes a new "Lecture Experiment," for the illustration of the present method of preparing bicarbonate of soda, which consists essentially of a cylinder filled with a saturated solution of NaCl, and separated into divisions by wire-gauze.  $CO_2$  is introduced at the bottom of the cylinder, and  $NH_3$  at the top. The resultant ammonium bicarbonate is decomposed by the NaCl solution into ammonium chloride and sodium bicarbonate, which is deposited on the wire nets.

C. WOLFF, "Diallyl-aceto-acetic Ether and its Derivatives." This ether,  $CH_3.CO.C(C_3H_5)_2.COOC_2H_5$ , is obtained, by the action of allylic iodide on sodium-allyl-aceto-acetic ether, as a colourless oil, boiling at  $240^\circ$ . By heating with potash it is decomposed into diallyl-aceton,  $CH_3.CO.CH(C_3H_5)_2$ , a colourless, oily liquid, boiling at  $175^\circ$ ; and diallyl-acetic acid,  $CH(C_3H_5)_2.COOH$ , which boils at  $222^\circ$ .

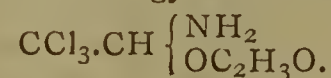
M. REIMANN, "Action of Precipitated Sulphur in Dyeing." Since the introduction of aniline-green as a dye for woollen fabrics the only mordant used has been a warm solution of sodium hyposulphite which has been treated with HCl. The author, regarding its action as analogous to that of precipitated silicic acid in aniline dyeing, considers the "sulphur milk" thus formed to be the true mordant. The following experiments show the correctness of the theory:—The cloudiness resulting from the addition of HCl to a solution of hyposulphite, and consisting of finely-divided sulphur, is entirely removed by introducing woollen threads into the solution. Samples of threads which have been soaked in  $CS_2$  take exactly the same shade, on immersion in the aniline bath, as those treated with "sulphur milk." The latter threads also, after being boiled with HNaO and treated with HCl, emitted a trace of  $H_2S$ , and lost their power of fixing colours. The author is investigating the action of sulphur as used for eosin and its derivative dye-stuffs, and the practicability of its more general application in dyeing.

C. A. BELL and E. LAPPER obtain, by the "Dry Distillation of Ammonium Saccharate," pyrrol,—

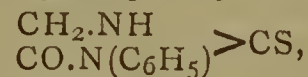


and, by the distillation of ethyl-amine saccharate, ethyl-pyrrol. The isomeric mucic acid yields in both cases pyrrolo-amides. Theoretical considerations on the formulæ of the acids follow.

A. PINNER, "Chloral Derivatives." In opposition to Schiff's views, the author considers that in the compounds of the chlorals with acetamide, &c., the acetyl group is not united to N from analogy with the compound—

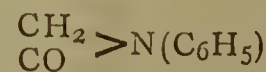


P. J. MEYER, "Substituted Sulpho-hydantoïns." Sulpho-carbamide and chlor-acet-anilide yield, on heating, sulpho-hydantoïn and phenyl-sulpho-hydantoïn,—



yellow crystals, insoluble in  $H_2O$ , melting at  $178^\circ$ . Chlor-aceto-toluidide forms a similar compound, toluyll-sulpho-hydantoïn.

"Action of Heat on Glycocolls." Phenyl-glycocoll, when heated at  $140^\circ$  to  $150^\circ$ , loses  $H_2O$ , and yields the two bodies—

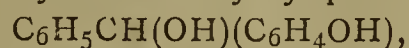


and—



O. DOEBNER, "*Synthesis of Oxyketones by the Introduction of Acid Radicals into Phenols.*" The author has ascertained that acid radicals are easily substituted for H in phenols, if an acid radical is previously introduced into the hydroxyl group of the phenol. Thus phenol, on treatment with benzoyl chloride, yields phenyl-benzoate,  $C_6H_5OOC.C_6H_5$ , which, on further treatment with zinc chloride and benzoyl chloride, is changed into benzoyl-phenol-benzoate,  $C_6H_5CO.C_6H_4O.OOC.C_6H_5$ , i.e., the ether of benzoyl-phenol.

O. DOEBNER and W. STACKMANN, "*Benzoyl-phenol.*" The authors prepare this from the above-mentioned benzoyl-phenol-benzoate, by saponification with alcoholic potash, solution in  $H_2O$ , and precipitation with  $CO_2$ . The acetate  $C_6H_5COC_6H_4O(COCH_3)$ , obtained by heating with acetic anhydride, crystallises in colourless needles, and is easily decomposed by alkalis. Reduction with sodium-amalgam yields benzhydryl-phenol,—



possessing the properties of a secondary alcohol and a phenol. By fusion with HKO benzoyl-phenol yields paroxy-benzoic acid, which would seem to show that it belongs to the para series.

## CORRESPONDENCE.

### CONTRIBUTIONS TO CHEMICAL ANALYSIS.

*To the Editor of the Chemical News.*

SIR,—Will you kindly insert in your journal the following letter?—

During the last few months I could not find enough time to analyse Mr. A. H. Allen's letter (CHEM. NEWS, vol. xxxvi., p. 33), in which thunder and lightning was sent against my small notes published from time to time in your valuable periodical.

I will try to answer as briefly as possible.

1. The erroneous percentage of P in  $Mg_2P_2O_7$ , given by me in my paper (CHEM. NEWS, vol. xxxv., p. 1) was a mistake made by me indeed while writing the article. This fact I acknowledge.

2. In my paper on analyses of slags, clays, &c. (CHEM. NEWS, vol. xxxv., p. 203) it is mentioned that  $Mg_2P_2O_7$  contains 36.04 per cent of *magnesium*: this should have been *magnesia*. The error is evident, as this metal, in analyses of clays, slags, iron ores, &c., is always calculated as *magnesia*.

3. The wonderful error in the calculation of the percentage of chromium in chrome-iron ores (CHEM. NEWS, vol. xxxv., p. 107) showed me—unfortunately after the appearance of the paper in the press—that calculations should always be made by chemists themselves, and not by other persons, as it happened in the present case.

4. Some words on the metal davyum. Bunsen, indeed, pointed out the probability of the existence of some new metals in the platinum group. The author certainly knew this fact, and it lessened the task of the discoverer. It is well to mention here that M. Lecoq de Boisbaudran discovered, as it is known, the metal gallium, which was found to be M. Mendeleeff's hypothetical element, *eka-aluminium*, the properties of which quite agree with those of gallium given by M. Mendeleeff (*Comptes Rendus*, No. 21, Nov. 22, 1875). In this case M. Mendeleeff may easily claim the discovery of gallium under another name only. I think if one person supposed that a metal existed and another found it out, the last may certainly claim the discovery. Mr. Allen tells us that the reactions of davyum show nothing exceptional. I suppose, and many I think suppose, that a preliminary notice cannot give details. In my further communications (CHEM. NEWS, vol. xxxvi., pp. 114, 155) some particular reactions are described; further work will show something new again. In chemistry,

as in every science, a new discovery cannot be worked out at once. Mr. Allen remarks, also, that the reaction of Da with KCyS is not shared only by iron (and remarks that I suppose so), but that it is common also to uranium and ruthenium, and *probably* to other metals (?). First, I cannot understand why Mr. Allen thinks that I suppose the iron only to have a reaction with KCNS, similar to the reaction of Da with KCys. That is an open question. I simply notice in my paper (CHEM. NEWS, vol. xxxvi., p. 4) that the "davyum chloride gives, with potassium, sulpho-cyanide—a red colouration, identical with the colouration produced by mixing solutions of KCyS and  $FeSO_4$  (ferric salts)." Why should I not say so? If the colouration were a blue one I should mention that it is identical with the colouration of a solution of  $CuSO_4$ . Every chemist knows the reactions of Fe, Ur, and Ru, and if Mr. Allen wished to tell that the reaction between Da and KCyS is not characteristic I may add the following:—With potassium sulpho-cyanide—

Ru gives a rose colouration, which on heating the liquor turns purple. (Bunsen ascribes this reaction to the presence of other unknown metals of the platinum group.)

Fe, red colouration; no precipitate.

Ur, dark yellow colouration; the liquor on being heated gives a yellowish white precipitate; the precipitation is not full

Da, red colouration in feeble solutions of the metal; red precipitate in concentrated solutions.

5. In conclusion, I append a note on the inference of Mr. Allen:—The  $H_2S$  and  $SO_2$  are frequent not only in Russian coal-gas, which in St. Petersburg is made entirely from English coals; and I find nothing strange in passing it through a compound absorbing the above-mentioned gases, noxious in regard to platinum.—I am, &c.,

SERGIUS KERN.

48, Rue aux Pois, St. Petersburg,  
October 30, 1877.

### ACTION OF SULPHURIC ACID AND OXIDISING AGENTS ON MORPHIA AND ITS SALTS.

*To the Editor of the Chemical News.*

SIR,—In the CHEMICAL NEWS (vol. xxxvi., page 228) Mr. David Lindo contributes a paper on the above subject. The reaction there described may be one of considerable delicacy, but it is by no means characteristic of morphia. I have found that both codeia and narcotin, when warmed with hydric sulphate, diluted with water, and mixed with nitric acid in the manner recommended by Mr. Lindo, give colour-reactions practically undistinguishable from that produced by morphia and its salts when similarly treated. Potassic dichromate may be substituted for nitric acid, whence it is probable that other oxidising agents would act in the same way. The test in question, with thebaine, papaverine, and narceine, gives only negative results.—I am, &c.,

DAVID B. DOTT.

93, Abbey Hill, Edinburgh, Nov. 30, 1877.

### MARBELLA IRONSTONE.

*To the Editor of the Chemical News.*

SIR,—I think that if any user of Marbella ore accepts the analysis given by Dr. Wallace in your issue of last week he will find himself mistaken. I do not in the least doubt that Dr. Wallace made his analysis quite correctly, but I feel sure he must have had a particularly good sample sent to him, or the ore must have been better when he analysed it than it is now. I have had to work with large quantities of Marbella, and have had a good many analyses made, and instead of traces only of bisulphide of

on I have invariably found a considerable quantity, usually an amount equivalent to two-tenths per cent of sulphur, sometimes less, sometimes more. Lime averages 1 per cent, and magnesia between 6 and 7 per cent. The iron varies between 56 and 59, and may be taken as averaging 57½. The samples I had taken were from cargoes, and were fairly taken, in the case of large cargoes amounting even to tons; these samples were broken, halved, broken smaller, again halved, again broken, and so on.

I would not have wished to take up your space, but that I feared some persons might be led to consider the ore as remarkably pure, which the bulk is not, though it would be easy to pick out some very good pieces.—I am, &c.,

G. S. PACKER.

Hallside by Glasgow, Dec. 3, 1877.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 21, November 19, 1877.

New Remarks on the Quantities of Heat Liberated by the Mixture of Water with Sulphuric Acid.—M. Berthelot.—The properties of sulphuric acid are always the same, and it evolves identical quantities of heat whether it has been recently heated or preserved for a considerable time. The author has ascertained this fact with precision on two occasions, having been led to examine it in the course of other researches. The following are the numbers obtained on causing 1 part of boiled acid (containing about 98 per cent of real acid) to act upon 70 parts of water:—

	Calories.
Acid kept several years, at 22° .. ..	168.2
Acid kept for a month, at 20° .. ..	167.0
Acid lately heated to ebullition, at 17°	166.6

The differences between these numbers are very trifling, and are further reduced if all the figures are calculated for the same temperature, say 22°:—168.2; 167.7; 168.3.

Use of Neutral Refined Oils for Lubricating Pistons in Engines Fitted with Surface Condensers.—M. O. Allaire.—The author investigates the nature of the deposits formed in the condensers and in the boilers of marine engines. If the oils hitherto used for lubricating cylinders yield about 50 per cent of their weight of a residue containing more than one-half of oxide of iron, an oil where the free acids have been removed yields only 19 per cent of a residue containing merely 6 per cent oxide of iron. All oils, without exception, even such as have not undergone any treatment with acids, contain a very large proportion of free acids, to which the formation of the deposits is ascribed.

Reproduction of Orthose.—M. P. Hautefeuille.—Orthose may be artificially prepared by heating to between 900° and 1000° a mixture of tungstic acid and of a very alkaline silico-aluminate of potassa, containing 1 equiv. of alumina to 6 equivs. of silica.

Composition and the Industrial Use of the Gases from Metallurgical Furnaces.—M. L. Cailletet.—On collecting the gases which circulate in the hottest part of iron furnaces the author, by the aid of an apparatus analogous to that of M. Deville, has been able to show that the composition of these gases, when cooled suddenly, differs completely from the results given by the analyses of Ebelmen. This skilful metallurgist, ignoring the phenomena of dissociation, collected the gases by aspiring them

slowly through a long tube, which necessarily involved the combination of their dissociated elements. In the analyses of Ebelmen the reaction seems almost always complete, whilst the sudden cooling of the gases shows that smoke and carburetted gases may exist in the presence of oxygen at the temperature of melting iron. The author considers it proved by his experiments that the gases evolved from metallurgical furnaces still contain, even after their passage under steam boilers, an important quantity of combustible matter, which it is easy to ignite and to burn almost entirely. The passage or reducing gases along metallic surfaces at a red heat may receive important metallurgical operations in addition to the annealing of sheet-iron.

Formation of Iodous Acid by the Action of Ozone upon Iodine.—M. J. Ogier.—We may operate, either by causing ozonised oxygen to act upon the vapour of iodine, or by submitting a mixture of oxygen and iodine to the electric effluve. In each case the products are the same: the ultimate stage of an oxidation sufficiently prolonged is always a white or yellowish matter, unalterable in the air, soluble in water without apparent decomposition, and in which the oxygen and iodine were found united in the proportions suitable for iodic acid. In certain cases the author obtained a product sparingly soluble in water, the properties of which agreed with Millon's hypoiodic acid. The following arrangement was adopted for the formation of iodous acid:—A rapid current of ozone was led by a tube to the bottom of a flask containing iodine kept at 44° to 50°. The ozone being immediately destroyed on contact with the vapour of iodine, the solid particles formed were carried with the excess of oxygen along a lateral tube. A series of narrow glass tubes containing platinum spirals serves to break the gaseous current, and to arrest these particles whose tenuity is extreme. The product is a pale yellow powder, exceedingly light. If treated with water iodine is precipitated. If exposed to moist air it seems to disappear in a few seconds.

Solubility of Sugar in Water.—M. H. Courtonne.—100 grms. of water at 12.5° dissolve 198.647 grms. of sugar, and at 45° 245 grms. In other words, a solution of sugar saturated at 12.5° contains 66.5 per cent, and a solution saturated at 45° contains 71 per cent.

Oxidation-Products of Camphor.—M. J. de Montgolfier.—An examination of the production of the camphic, camphoric, and oxycamphic acids.

Bismuth-Minerals of Bolivia, Peru, and Chili.—M. Domeyko.—The sulphuretted minerals are Bolivite, which appears to be an oxysulphide composed of protosulphide,  $\text{Bi}_2\text{S}_2$ , and of sesquioxide,  $\text{Bi}_2\text{O}_3$ . Bismuthine is found in considerable quantities in the mines of Chorolque, in Bolivia. A double sulphide of bismuth and copper occurs in the mines of Cerro Blanco, in the Chilian province of Atacama. A sulphide of bismuth rich in silver is found in the mine Santa Matilda, at Morocochu, in Peru. The principal oxidised minerals are taznite, a chloro-arsenate and chloro-antimoniate of bismuth, found at Tazna, in Bolivia. The oxychloride (Daubreite) comes from the superficial part of the same deposit. A compact, earthy, hydrated oxide is the most common Bolivian ore of bismuth. A hydrated silicate accompanies the sulphide at Chorolque. Native bismuth is very common in Bolivia, accompanying the oxysulphide of Tazna, and containing no tellurium. In other localities native bismuth is found along with gold. There is also a telluride of bismuth and silver.

*Bulletin de la Société Chimique de Paris,*  
No. 10, November 5, 1877.

Thermo-chemical Determinations.—M. Berthelot.—These determinations relate to the oxides of nitrogen; to oxy-ammonia,  $\text{N} + \text{H}_3 + \text{O}_2$ ; to the compounds of the halogens; the cyanogen series, &c.; the heat of combination referred to the solid state; the formation of solid salts

from hydrated acids and bases, both solids; the formation of various organic compounds from their elements, *i.e.*, gaseous hydrogen, oxygen, and nitrogen, and carbon as diamond; and the formation of ethers by means of alcohols.

**Iodide of Starch.**—M. Bondonneau.—Already noticed.

**New Researches on the Ammoniacal Fermentation of Urine, and on Spontaneous Fermentation.**—MM. Paul Cazeneuve and Charles Livon.—When the urine of animals is exposed to the air the urea becomes hydrated, and is resolved into carbonate of ammonia, whilst vibriones make their appearance in the liquid. These facts meet with various interpretations. Müller, Pasteur, and Van Tieghem ascribe the hydration of the urea to the action of a special *Torulacea*. Pasteur and Joubert consider that this action of the *Torulacea* is due more directly to the secretion of a soluble ferment, a sort of diastase. Fremy considers that a "hemi-organic" substance, present in all animal and vegetable liquids, is the immediate cause of the transformation of the urea. M. Béchamp finds in all animal humours molecular granulations, to which he ascribes life, and lets them play an active part in all fermentations under the name of microzymas. He supposes that in urine there are abnormal microzymas, which transform urea into carbonate of ammonia. Verneuil thinks that leucocytes may modify urea like the *torulacea* of Pasteur and Van Tieghem. M. Bouley ascribes the change possibly to pus, blood, or mucus, whilst Poggiale hesitates to attribute this part of hydration exclusively to the *torulacea*. As regards the origin of the vibriones there are two conflicting schools—the heterogenists (Dr. Bastian, Onimus, &c.), who believe in the creation of the little beings in the midst of the urine by the concurrence of physico-chemical forces; and the physiological school, of which Pasteur is the most eminent representative, and which ascribes the birth of vibriones to vibriones, the air being a means of transport of these animalcules and their germs. The authors have experimented on the subject—not in glass vessels, like M. Pasteur—but in the bladders of living animals, or, as they rather curiously express it, *in anima vili*! The urine of dogs was rendered alkaline, either by the administration of bicarbonate of soda, acetate of potassa, &c., or by certain nervous lesions, but when withdrawn from the bladder by means of an operation it was invariably found free from ammoniacal fermentation, and contained neither *torulaceæ* nor vibriones. If, however, air was admitted into the bladder by a slit, ammoniacal fermentation speedily set in, and vibriones made their appearance.

**Formation of Allylen at the expense of the Bromocitraconic and Bromo-citra-pyrotartaric Anhydrides.**—M. E. Bourgoin.—The author having dissolved bromo-citra-pyro-tartaric anhydride in water, saturated the solution with ammonia, and added silver nitrate in excess, heated the resulting salt for some hours to 130° in a closed vessel. On opening the tube a large quantity of gas escaped which proved to be allylen.

**Action of Hydrochloric Acid upon two Isomeric Butylens and upon the Olefines in General.**—M. J. A. Le Bel.

*Justus Liebig's Annalen der Chemie,*  
Band 189, Heft 3.

**Chemical Compounds in Liquid Storax.**—Dr. W. von Miller (Second treatise).—We have here an account of styrol, styracin, cinnamic-phenyl-propylester, and storesin.

**New Method of Determining Casein and Fats in Milk.**—Julius Lehmann.—The author after pointing out the impossibility of deciding on the quality of milk otherwise than by a quantitative analysis, and after pronouncing all known methods too tedious and circumstantial, speaks of his experiments on the behaviour of milk upon baked plates of porous clay. From these ex-

periments it appears that if milk is poured slowly upon such plates by means of a pipette or small glass syringe in a continuous stratum of about 2 m.m. in thickness there remains, after the lapse of one or two hours, a consistent coating with a sharply defined outline, of a pale yellowish colour and a fatty lustre, which can be readily removed from the plate by means of a sharp horn spatula in the form of fine translucent laminae. After exposure for some time to moderately dry air, or especially if dried over sulphuric acid, they become so brittle that they can be broken between the fingers. At a temperature of about 30° fat exudes out of the laminae, and covers their entire surface. After extraction with ether there remains a white, translucent, easily friable mass. This, when thoroughly freed from fat, consists of casein, containing ash, and very small proportions of albumen and milk-sugar. Hence the two latter substances are capable of being separated from the serum by means of clay plates. It further appears that in this manner casein may be separated with the same properties as if it had been precipitated by rennet. If rubbed up with water it swells to a white flocculent matter, which remains behind on filtering the mixture through blotting-paper. On treatment with lime-water it returns to the state in which it originally existed in the milk. It then passes through filter-paper along with water, and can be precipitated with acetic acid. If the casein still retains the proportion of fat which was left with it upon the plates of clay, it forms, when rubbed up with lime-water, a liquid quite similar to milk. In this casein, and in that precipitated with rennet, the proportion of ash is on an average 8.5 per cent, whilst that precipitated with acetic acid contains only 1.8 per cent, the chief constituent of which, in the latter case, is dihydro-calcium phosphate, whilst in the two former it is neutral tri-calcium phosphate. The above observations confirm the view of Hoppe-Seyler, of Soxhlet, and Hammarsten, that casein exists in milk not in solution but merely in a strongly swollen state. If dissolved it would be absorbed by the clay plates like the albumen. The same observations prove that the fat-globules in milk are not enveloped in capsules of solid matter, since the fat exudes at a gentle heat, and can be readily washed away with ether. The application of these observations to the quantitative determination of casein and milk-sugar depends, in the first place, on the existence of earthenware plates with pores so fine as not to absorb the milk-globules as such. The author has been able to procure such plates from one firm only. The method of performing the analysis is as follows:—Suitable plates, after having been heated for some time to about 100° and cooled again, are held in a sloping position, quickly drenched with a thin stream of water upon their smooth surface, and placed on a glass vessel of suitable width, the bottom of which is covered with a thin layer of concentrated sulphuric acid. The milk in question, previously diluted with an equal weight of distilled water, is cautiously run upon the middle part of the plate in a connected layer by means of a small glass syringe, and covered with a smooth-edged glass capsule to prevent evaporation. To ascertain the weight of the portion taken for analysis the syringe is weighed both before and after pouring the milk upon the plate. From 9 to 10 grms. of diluted milk are sufficient. After the lapse of one to two hours the serum will be found to have been absorbed to such an extent that the cake can be removed by means of a sharp horn spatula specially designed by the author for this purpose, and placed in a balanced watch-glass. This residue is then dried in the air-bath at 105°, which can be completed in two hours, and weighed. In this manner the joint weight of casein and fat is obtained. The dry matter, without being previously pulverised, is placed upon a tared filter, dried at 105°, by means of forceps, and washed in the first place with a small quantity of ether. It is then thrown into a small smooth glass mortar provided with a spout, and most finely pulverised with the addition of a few drops of absolute alcohol, ether is added, so as to wash the whole

into the filter, where it is further washed till completely free from fat. After the evaporation of the filtrate of alcohol and ether the fat remains in the small flask, which must be previously tared, and which is weighed again when the evaporation is completed. In order to determine the casein, it is merely needful to dry the filter with the residue as long as any loss of weight takes place, and then to weigh. As the casein contains a considerable proportion of ash this must be separately determined and deducted. The casein thus obtained, on being submitted to ultimate analysis by the soda-lime process, was found to contain 15.57 per cent of nitrogen as calculated for the pure substance free from ash. On comparing the results with those obtained by Hoppe-Seyler's process the amount of casein appears greater according to the former, especially as in the latter method a part of the precipitate obtained with acetic acid is re-dissolved on washing. The 1.8 per cent of ash contained in the casein obtained on Hoppe-Seyler's method has hitherto been left entirely unnoticed. The author announces that as soon as a stock of suitable clay plates have been prepared he will give the address of the firm from whom both these and all other articles required for the execution of the process may be obtained.

**New Derivative of Sulpho-urea: Sulph-hydantoic Acid, or Sulpho-carbamid-acetic Acid.**—R. Maly.—Not suitable for abstraction.

## MISCELLANEOUS.

**Royal Institution of Great Britain.**—At the general monthly meeting, held on Monday last, the following arrangements of the Lectures before Easter, 1878, were announced:—

**Prof. Tyndall, D.C.L., F.R.S.**—Six Lectures adapted to a Juvenile Auditory, on Heat, Visible and Invisible; on Dec. 27 (Thursday), 29, 1877; Jan. 1, 3, 5, 8, 1878.

**Prof. Alfred H. Garrod, M.A., F.R.S.**—Twelve Lectures on the Protoplasmic Theory of Life and its Bearing on Physiology; on Tuesdays, Jan. 22 to April 9.

**James Dewar, M.A., F.R.S.**—Twelve Lectures on the Chemistry of the Organic World; on Thursdays, Jan. 24 to April 11.

**R. Bosworth Smith, M.A.**—Seven Lectures on Carthage and the Carthaginians; on Saturdays, Jan. 26 to March 9.

**Rev. W. Houghton.**—Three Lectures on the Natural History of the Ancients; on Saturdays, March 10, 23, 30.

**Ernst Pauer.**—Two Lectures on the Clavecinistes and their Works (England and Italy; France and Germany); with Musical Illustrations; on Saturdays, April 6, 13.

**Prof. Tyndall** will give a Course of Lectures after Easter.

The Friday Evening Meetings will begin on January 25, at 8 p.m., when Prof. Tyndall will give a discourse at 9 p.m. Succeeding Discourses will probably be given by W. H. Preece, Matthew Arnold, Dr. Philip L. Sclater, Prof. Roscoe, Dr. R. Liebreich, Prof. Goldwin Smith, Lord Rayleigh, Profs. Huxley and Dewar, Sir John Lubbock, and Sir Joseph D. Hooker.

## MEETINGS FOR THE WEEK.

**MONDAY, Dec. 10th.**—Society of Arts, 8. Cantor Lecture. "Manufacture of Paper," Lecture III., W. Arnot, F.C.S.

**WEDNESDAY, 12th.**—Society of Arts, 8. "Freedom in the Growth and Sale of the Crops of the Farm, considered in its Bearings upon the Interests of Landowners and Tenant Farmers," J. B. Lawes, F.R.S.

**SATURDAY, Dec. 15th.**—Physical, 3. "On Permanent Plateau's Films," by S. P. Thompson, B.Sc. "On the Coloured Figures Exhibited by Vibrating Fluid Films," by Sedley Taylor, M.A.

## TO CHEMICAL MANUFACTURERS AND OTHERS.

Sale of valuable Freehold Property, known as the Wepre Brook Chemical Works, situate about midway between the Connah's Quay and Queen's Ferry Station, on the Chester and Holyhead Railway, Flintshire.

## Messrs. CHURTON, ELPHICK, and CO.

beg to announce that they have been favoured with instructions to SELL BY AUCTION, at the Grosvenor Hotel, Chester, on SATURDAY, the 15th day of December, 1877, at 12 for 1 o'clock p.m., punctually (in one lot, and subject to such conditions as will then be produced), the valuable Freehold Premises, known as the WEPRE BROOK CHEMICAL WORKS, comprehending extensive ranges of substantially erected Buildings, including refineries, kiln house, chamber rooms, stove rooms, stabling, smith's shop, machine house, shed, three chimney stacks, &c.; also a range of Building comprising manager's house, offices, with yard, garden, &c.; together with the whole of the extremely valuable fixed PLANT and MACHINERY, which include six large lead chambers, acid and condensing towers, Spencer's patent and other kilns, boiling-down pans, refinery, salt-cake furnace, double and single flue boilers, steam-engines, pumps, weighing machines, cisterns, reservoirs, steam crane, &c., &c., all of which are in good working order, fit for immediate occupation, and well adapted to carry on an extensive business.

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Printed particulars with plans will be published, and may be obtained from Mr. S. Walker, Telegraph Street, Moorgate Street, London; Messrs. Wright, Bonner, and Wright, Solicitors, 41, King William Street, London Bridge; or from Messrs. Churton, Elphick Roberts, and Richardson, the Auctioneers, Chester.

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10 " " Sulphate of Ammonia,	
2 " " Sulphuric Acid,	
160 " " Chalk,	

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# THE CHEMICAL NEWS.

VOL. XXXVI. No. 942.

## REPORT ON THE DEVELOPMENT OF THE CHEMICAL ARTS DURING THE LAST TEN YEARS.\*

By Dr. A. W. HOFMANN.

*Phosphorus and Matches.* By Dr. ANTON VON SCHRÖTTER,  
Master of the Imperial Mint at Vienna.

(Concluded from p. 220.)

In the sister-kingdom of Norway the match trade has also taken root, although on a smaller scale. Amongst the countries in which this manufacture was earliest established and has been remarkably successful, Austria must not be forgotten, although its production is now less extensive than that of Sweden. The exportation of matches, wax-lights, &c., amounted to, in the years—

1870 .. .. .	46,684 kilos.
1871 .. .. .	43,685 „
1872 .. .. .	42,436 „

The decline of the trade is ascribed to heavy local taxation. There are at present 43 large and 79 smaller establishments in operation.

*Other Applications of Phosphorus.*—Phosphorus is employed not merely in the match trade but in so many other branches, both in a free state and in numerous compounds, that we cannot undertake their exhaustive description. The scientific chemist uses this element in innumerable investigations, as, *e.g.*, in the preparation of methyl- and ethyl-iodide, which, thanks to the labours of A. W. Hofmann, have become indispensable agents in research, and have found extensive application in chromo-technics. For such purposes amorphous phosphorus is often used instead of the ordinary kind, since its reactions are as a rule less violent.

In pharmacy phosphorus plays also an important part, although exclusively in the shape of one of its oxygen compounds, phosphoric acid. This acid is found to be an excellent medium for introducing into the organism the iron necessary for the formation of blood. For this reason ferric pyrophosphate, which has no inky flavour, and indeed very little perceptible taste, has rapidly become a favourite medicine, and is used in Grimault's iron-syrup, in Löflund's extract of malt, and in so-called "iron-sugar." As a reagent for many substances belonging to the *materia medica* phosphoric acid is also important. According to Kratschmer and Nowak† it is the best test for atropin; according to C. Scheibler‡ there is no better precipitant for nearly all organic bases than phospho-tungstic acid, a combination of phosphoric and tungstic acids equally available for scientific and technological purposes.

Particularly important is the method of Prof. E. N. Horsford, of Cambridge, U.S., for the preparation of bread without yeast, and consequently without fermentation, by means of phosphoric acid. Liebig§ considers this invention "one of the most important and beneficial that have been made within the last ten years." Prof. Horsford who, during his stay in Vienna as an Exhibition juror had the kindness to perform his process in the laboratory of the reporter, proceeds as follows:—White washed bone-ash (3 parts) are treated with about 2.4 parts of sulphuric acid, from which the small amount of lead present in the commercial acid has been previously precipitated by dilution with 10 parts of water. It is thus converted into the well-known calcium phosphate

[CaH<sub>2</sub>(PO<sub>4</sub>)<sub>2</sub>], which still contains one-third of the lime in the bones. After removing the gypsum the liquid, which also contains the magnesia of the bones, is concentrated to the consistence of honey, and when cold is mixed with 1 part of starch of any kind, thus forming when thoroughly kneaded together a crumbly mass, which, on exposure to a gentle heat, yields a white dry powder. To this is added bicarbonate of soda in the proportion of 3 parts of the phosphate to 1 of the soda-salt. Dough is now prepared with flour mixed with salt and with the above-mentioned baking powder, worked up well together and baked in the usual manner.

The carbonic acid thus liberated makes the bread light and porous, so that in this respect it differs, if at all, advantageously from that produced with yeast. If bicarbonate of potassa is used instead of the soda-salt the bread has a better flavour, and this procedure would be the more rational, since the greater part of the potash is withdrawn from the flour in the separation of the bran. Hitherto, however, the high price of the potash-salt stands in the way of this improvement. Liebig, however, proposes to substitute a mixture of the bicarbonate of soda and the chloride of potassium in the proportion of about 2 to 1 for the bicarbonate of potassa.

The advantages of a process so easily executed in every household, and the beneficial effects of this well-flavoured bread upon digestion are so evident that it would be superfluous to enter upon any detailed explanation. We may mention, however, that for armies in the field the value of this bread must be incalculable, as it is peculiarly adapted to serve for a time as a substitute for animal food. In America it is already produced in large quantities, and has become a substance of daily consumption. In the recent war it proved very useful. It is evidently possible to incorporate with this bread, by additions suited to circumstances, all the constituents of blood in the necessary proportion.\*

We may finally mention that phosphorus notably modifies the properties of metals with which it combines directly, and in the case of such as are strongly electro-positive even with the development of fire. This circumstance has met with technological applications, especially in the case of copper, which, by the addition of 1.2 to 1.5 per cent of phosphorus (phosphor-bronze), becomes harder, tougher, more fluid on fusion, and resists external influences better, *e.g.*, the action of sea-water. A plate of this bronze thus exposed for six months lost only 1.158 per cent of its weight, whilst a plate of the best English copper of equal size lost in the same time 3.058 per cent.

In the works of the Stephenson Tube Company, at Birmingham, phosphor-bronze has been produced on the large scale since 1865, and is used for tubes, barrels for fire-arms of all kinds, cylinders for calico-printing, &c.

Larger proportions of phosphorus render copper white and perfectly brittle. What is the exact part which small quantities of phosphorus may play when alloyed with copper is not quite clear. It may possibly, as Dumas supposes, act principally upon the oxides mixed with the copper, and which, when converted into phosphides may distribute themselves in the mass, thus rendering it harder, tougher, and more elastic.

The phosphor-bronze from the works of G. Höpner and Co., at Iserlohn, is already extensively used for the bearings of axles, for gun-barrels, plating, weights, &c. (See the paper on "Copper" in a subsequent part of this Report.)

If phosphate of copper, obtained by precipitating sulphate of copper with phosphate of soda, is mixed with charcoal and exposed to a strong red heat, a white brittle copper phosphide is obtained, very rich in phosphorus, by the aid of which alloys of any desired composition can be most advantageously obtained.

Phosphates have been experimentally used in the glass manufacture, but without any marked benefit. The glass takes a yellow colour.†

\* "Berichte über die Entwicklung der Chemischen Industrie Während des Letzten Jahrzehends."

† Kratschmer and Nowak, *Vien. Acad. Ber.*, ii., 69.

‡ Scheibler, *Dingl. Pol. Journ.*, ccix., 141.

§ Liebig, *Ann. Chem. Pharm.*, cxlix., 37; *Wagner Jahresber.*, 1869, 470.

\* See "Theory and Art of Bread-Making: A New Process without the Use of Ferment," by Prof. E. N. Horsford.

† Pelouze, *Ann. Chim. Phys.*, [4], v., 465.

## APPLICATION OF ORGANIC ACIDS TO THE EXAMINATION OF MINERALS.

By H. CARRINGTON BOLTON.

(Continued from p. 250).

## II. SULPHIDES.

Mineral.	Formula.	Description.	Locality.
Stibnite .....	$\text{Sb}_2\text{S}_3$	fibrous, massive .....	Arkansas.
Molybdenite' .....	$\text{MoS}_2$	scales .....	Germany.
Argentite (1) .....	$\text{AgS}$	with $\text{PbS}$ and $\text{SiO}_2$ ....	Virginia City, Nev.
„ (2) .....		massive, pure .....	Cornucopia, Nev.
Galenite .....	$\text{PbS}$	cleavable, massive ....	Missouri.
Bornite (1) .....	$(\text{CuFe})\text{S}$	massive .....	Acton, Canada.
„ (2) and (3) ..		two samples, very pure	Harvey Hill, Canada.
„ (4) .....		massive .....	Germany.
Sphalerite .....	$\text{ZnS}$	massive .....	Friedensville, Pa.
Chalcocite (1) & (3)	$\text{CuS}$	massive .....	Chili, S.A.
„ (2) ....		crystals .....	Bristol, Conn.
Cinnabar .....	$\text{HgS}$	granular, massive.....	California.
Pyrrhotite (1) ....	$\text{Fe}_7\text{S}_8$	granular, massive.....	North Carolina.
„ (2) ....		granular, massive.....	Litchfield, Conn.
„ (3) .....		massive .....	Anthony's Nose, N.Y.
Niccolite.....	$\text{NiAs}$	massive .....	Tangerhausen.
Smaltite .....	$(\text{CoFeNi})\text{As}_2$	massive .....	Germany.
Pyrite (1) .....	$\text{FeS}_2$	massive .....	Germany.
„ (2) .....		massive .....	Freiberg, Saxony.
„ (3) .....		massive .....	Colorado.
Chalcopyrite (1) ..	$\text{CuS.FeS.FeS}_2$	massive .....	Acton, Canada.
„ (2) ..		massive .....	Harvey Hill, Canada.
„ (3) ..		massive .....	Colorado.
„ (4) ..		massive .....	Ore Knob, N.C.
Ulmannite'.....	$\text{NiS}_2 + \text{Ni}(\text{SbAs})_2$	.....	Petersbach.
Marcasite .....	$\text{FeS}_2$	crystalline .....	Germany.
Arsenopyrite .....	$\text{FeS}_2 + \text{FeAs}_2$	massive .....	Norwalk, Conn.
Bournonite.....	$3(\text{CuPb})\text{S} + \text{Sb}_2\text{S}_3$	massive .....	Germany.
Tetrahedrite'.....	$4\text{CuS} + \text{Sb}_2\text{S}_3$	granular .....	Freiberg, Saxony.

## III. OXIDES.

Mineral.	Formula.	Description.	Local
Cuprite .....	$\text{Cu}_2\text{O}$	massive .....	Siberia.
Zincite .....	$\text{ZnO}$	massive .....	Sterling, N.J

Mineral.	Formula.	Description.	Locality.
Hematite (1) .....	$\overset{\cdot\cdot\cdot}{\text{Fe}}$	micaceous .....	Michigan.
„ (2) .....		red, massive .....	Missouri.
Magnetite (1) ....	$\overset{\cdot\cdot\cdot}{\text{Fe}}\overset{\cdot\cdot\cdot}{\text{Fe}}$	massive granular.....	Canada.
„ (2) ....		.....	Saratoga Co., N.Y.
Limonite (1) .....	$\overset{\cdot\cdot\cdot}{\text{Fe}}_2\overset{\cdot\cdot\cdot}{\text{H}}_3$	botryoidal .....	Salisbury, Connecticut.
„ (2) .....		fibrous .....	Anniston, Ala.
Franklinite.....	$(\overset{\cdot\cdot\cdot}{\text{Fe}}\overset{\cdot\cdot\cdot}{\text{Zn}}\overset{\cdot\cdot\cdot}{\text{Mn}})(\overset{\cdot\cdot\cdot}{\text{Fe}}\overset{\cdot\cdot\cdot}{\text{Mn}})$	massive .....	Franklin, N.J.
Chromite .....	$\overset{\cdot\cdot\cdot}{\text{Fe}}\overset{\cdot\cdot\cdot}{\text{Cr}}$	massive .....	California.
Uraninite .....	$\overset{\cdot\cdot\cdot}{\text{U}}\overset{\cdot\cdot\cdot}{\text{U}}$	massive .....	Bohemia.
Hausmannite ....	$\overset{\cdot\cdot\cdot}{\text{Mn}}_2\overset{\cdot\cdot\cdot}{\text{Mn}}$	crystalline .....	Thuringia.
Pyrolusite .....	$\overset{\cdot\cdot\cdot}{\text{Mn}}$	massive, granular.....	New Brunswick (?)
Manganite.....	$\overset{\cdot\cdot\cdot}{\text{Mn}}\overset{\cdot\cdot\cdot}{\text{H}}$	crystalline .....	Ilefeld, Hartz Mountains.
Psilomelane .....	$(\overset{\cdot\cdot\cdot}{\text{Ba}}\overset{\cdot\cdot\cdot}{\text{Mn}})\overset{\cdot\cdot\cdot}{\text{Mn}}+\overset{\cdot\cdot\cdot}{\text{Mn}}$	massive .....	Germany.
Wad .....	$\overset{\cdot\cdot\cdot}{\text{R}}\overset{\cdot\cdot\cdot}{\text{Mn}}+\overset{\cdot\cdot\cdot}{\text{H}}$	earthy .....	Saxony.
Brucite .....	$\overset{\cdot\cdot\cdot}{\text{Mg}}\overset{\cdot\cdot\cdot}{\text{H}}$	foliated .....	Texas, Pa.

(To be continued).

NOTE ON THE DETECTION OF MINUTE  
TRACES OF BISMUTH.

By FREDERICK FIELD, F.R.S.

IN the CHEMICAL NEWS (vol. xxxvi., p. 249) Mr. Hutchings has written an interesting paper upon the detection of bismuth by Von Kobell's test, proposing as a modification the employment of cuprous iodide in place of potassium iodide, finding that the mixture of the former salt with sulphur has not only the advantage of being non-deliquescent, but is superior for use with the test. Mr. Hutchings proceeds to state "that the value of this test of Von Kobell is very great: it deserves to rank as one of the best—in some cases the best—test for bismuth."

Although far from undervaluing the observation of Von Kobell, or the modification proposed by Mr. Hutchings, I think when it is termed the *best* test, and as little as 0.2 or 0.1 per cent can be detected by it in many cases, the writer of the paper must have overlooked a somewhat exhaustive notice on "Some Results of the Analysis of Commercial Coppers" by Prof. Abel and myself, wherein the detection of bismuth is fully entered into, and showing how excessively small quantities of that metal are easily recognised.

The paper was read before the Chemical Society as far back as the year 1862 (see *Journ. Chem. Soc.*, vol. xiv., p. 290). The authors say—"As regards the qualitative examination for bismuth in copper, considerable advantages, in point of delicacy and rapidity of execution over the quantitative method described in a former part of this paper, are possessed by a mode of testing for that metal, which is based upon a curious reaction exhibited by iodide of potassium in the joint presence of bismuth and lead, and which we believe has not hitherto been noticed. When iodide of potassium is added to a solution of a lead salt it is well known that yellow iodide of lead is precipitated, which dissolves on heating the liquid, and is reprecipitated on cooling in brilliant golden-coloured scales. (The solution of the amorphous iodide may be greatly facilitated by the addition of a small quantity of hydrochloric acid.) If the least trace of bismuth is present in

the lead salt the precipitated scales are no longer yellow, but assume a dark orange or crimson tint, varying in intensity of colour according to the amount of bismuth present. This test is of such extraordinary delicacy that 0.00025 of a grain of bismuth may be detected in copper with the greatest ease, the iodide of lead becoming dark orange, while 0.001 grain imparts a reddish brown tinge and 0.01 grain a bright crimson, the scales resembling chromate of silver in appearance. The mode of operation in applying this test is as follows:—About 100 grains of the copper to be examined are dissolved in nitric acid, a solution of nitrate of lead, equal to about 5 grains of the salt, is added, and subsequently ammonia and carbonate of ammonia. The solution is washed with ammoniacal water, and dissolved in warm acetic acid. Considerable excess of iodide of potassium is introduced, and the liquid is warmed until the precipitate disappears. On cooling, the crystalline scales will show by their colour the presence or absence of bismuth."

By this most delicate test bismuth has been found in coppers hitherto regarded as quite free from the metal. Nearly all the modern copper coinage, more especially that of George III. and IV., contains very considerable traces, and in the new bronze currency it is abundantly evident. It has been found in copper rolled out to a ribbon, and in all copper gauzes, wire and foil.

It appears from this that bismuth is very universally disseminated, and further researches proved that it exists in nearly all specimens of blister, bar, and refined copper from Chile, Mexico, Australia, North America, Buenos Ayres, Manilla, Spain, Russia, Sweden, Norway, Italy, and Hungary, and in nearly all copper money, from that of the present day to the Bactrian coins (181 B.C.).

One of us still further experimented upon specimens of cupreous ores from nearly every part of the world, and although in ~~the~~ carbonates, atacamite, &c., bismuth was never found, it was almost universally discovered in the simple and double sulphides.

I may be pardoned for recapitulating experiments made many years ago, as I feel certain the test proposed by Prof. Abel and myself is of far greater delicacy than that

recommended by Mr. Hutchings. I am engaged at present upon the detection of bismuth in the non-cupriferous English minerals.

## THE DERIVATIVES OF BENZENE.

By P. T. MAIN.

THE subjoined extension to all the substitution-derivatives of benzene of the plan alluded to in the twelfth edition of "Fownes's Chemistry" (pp. 423, 424: Organic Chemistry) for distinguishing the varieties of di-derivative—without direct reference (in the propositions deduced) to the supposed position of the replaced atoms of hydrogen in the benzene ring—may be interesting to some readers of the CHEMICAL NEWS. By enabling a student of isomerism among the aromatic compounds to dispense with unsuggestive prefixes such as para, ortho, and meta, and bewildering collocations of numerals such as (1:2:4), (1:2:5), (1:3:6), and to use in place of these only the very suggestive distinguishing marks—as will be seen—(1), (2), (3), it may even be found practically useful.

When hydrogen is replaced twice in the benzene ring there are three varieties of *di-derivative*, according as the two hydrogens replaced occupy symmetrical, consecutive, or unsymmetrical positions; call these di-derivatives respectively (1), (2), and (3) di-derivatives.

Similarly, there are three varieties of *tri-derivatives*, according as the three hydrogens replaced occupy symmetrical, consecutive, or unsymmetrical positions; also three varieties of *tetra-derivative*, according as the four hydrogens replaced have a symmetrical, consecutive, or unsymmetrical arrangement on the benzene ring. Distinguish these three varieties of tri-derivatives as (1), (2), and (3) respectively, and similarly the three varieties of tetra-derivative. The following propositions are then easily proved by referring to diagrams representing the benzene rings with the positions of the replaced hydrogens marked for the three varieties in each case of di-, tri-, and tetra-derivative.

*Proposition I.*—A *di-derivative* belongs to variety (1), (2), or (3), according as it is related to (that is, can give rise to or be formed from) *one* only, *two* only, or all *three* of the varieties of tri-derivative. Thus—

- |     |                             |                   |                      |
|-----|-----------------------------|-------------------|----------------------|
| (1) | di-derivative is related to | (3)               | tri-derivative only. |
| (2) | "                           | (2) and (3)       | tri-deriv. only.     |
| (3) | "                           | (1), (2), and (3) | ditto all.           |

*Proposition II.*—A *tri-derivative* belongs to variety (1), (2), or (3) according as it is related to *one* only, *two* only or all *three* of the varieties, either of the di-derivative or of the tetra-derivative.

*Proposition III.*—A *tetra-derivative* belongs to variety (1), (2), or (3), according as it is related to *one* only, *two* only, or all *three* of the varieties of tri-derivative.

To show that the above propositions define the derivatives independently of the benzene ring is easy; for in the case where all the hydrogens are replaced by the *same* element or group it is known that there are only three di-, three tri-, and three tetra-derivatives; that is, that each variety consists of one member only for each element, as, for example, chlorine. In this case, then, Proposition I. defines the dichloro-derivative, according as

it is related to one only, two only, or all three of the isomeric trichloro-derivatives: and Proposition II. defines, then, the trichloro-derivatives as (1), (2), or (3), according to their relation to the dichloro-derivatives. Similarly, the tetra-chloro-derivatives are defined by Proposition III. by their relation to the tri-chloro-derivatives. And all the other di-, tri-, and tetra-derivatives differ from the (1), (2), (3) di-chloro-, tri-chloro-, or tetra-chloro-compounds in that one, or all the chlorines are replaced by some other element or group.

St. John's College, Cambridge,  
December 1, 1877.

## PROCEEDINGS OF SOCIETIES.

### CHEMICAL SOCIETY.

Thursday, December 6, 1877.

Dr. J. H. GLADSTONE, F.R.S., President, in the Chair.

AFTER the announcement of visitors and confirmation of the minutes of the last meeting, the list of presents to the library was read, and the thanks of the Society voted to the respective donors. The following certificates were read for the first time:—R. Bodmer, T. F. Harris, A. Jamieson, G. E. Stodart, W. Watson.

The PRESIDENT then announced that Prof. Odling was again unfortunately prevented from reading his paper "On Gallium," but that his assistant (Mr. Fisher) was present, and would give an abstract of it to the Society.

Mr. FISHER apologised for the absence of Prof. ODLING, stating that the lecture would have been deferred but for the fact that the specimens had to be returned shortly. He hoped, however, that Prof. Odling would give to the Society some theoretical considerations on the new metal at a future date. The following is a summary of the facts stated:—Gallium was discovered by Boisbaudran August 27 to 29, 1875. It was first obtained in the metallic state in November, 1875. Spectrum consists of two bands in the violet; one brilliant, of wave-length 417, and a feeble band of wave-length 403.3. It was extracted in the first instance from zinc-blende of Pierrefitte, a mine in the Pyrenees, afterwards from a black blende of Bensburg on the Rhine. The latter contains 1 part in 100,000; the former 1 in 400,000. 0.65 gram. of gallium being obtained from 430 kilogrms. of Pierrefitte blende. In appearance it resembles lead, but is less blue, tarnishes slightly on exposure to moist air: it is slightly harder than lead, flexible, malleable, and can be cut with a knife. It is not appreciably volatile at a red heat, and is but slightly attacked by oxygen at that temperature. Its specific gravity is 5.9; when fused 6.08. It melts at 30.15° C., presenting a brilliantly white appearance. When once fused it remains liquid, even for several months, at 0° C., but is immediately solidified when in this condition by contact with solid gallium. In consequence of this curious phenomenon of surfusion, the element was at first described as a liquid metal. Crystallises in square octahedra. In properties it is more or less intermediate between aluminium and indium. The solutions of its salts give the following reactions:—With ammonia, a white gelatinous precipitate, soluble, but not freely, in excess; potash, a similar precipitate, soluble in excess. Acetate of ammonia, on boiling in a solution free from excess of acid, precipitates a basic compound. Carbonate of baryta easily precipitates the salts of gallium in the cold. The salts already prepared are the sulphate, which is very soluble, but not deliquescent; the chloride, very soluble and very deliquescent, decomposed by a large ex-

cess of water, and the alum. A solution of the latter, on heating, deposits a basic sulphate, which goes up again on cooling.

In reply to some questions by the President and Mr. Groves,

Mr. FISHER stated that no satisfactory determinations of the atomic weight or specific heat of the new metal had yet been made, and pointed out that the small quantity (0.65 grm.) had prevented M. Boisbaudran from fully investigating some other reactions. Specimens of the metal and the alum were exhibited.

The next paper was "*On Nitrification: a Report of Experiments conducted in the Rothampsted Laboratory*," by R. WARINGTON. After pointing out the technical importance of the above process, and our want of knowledge as to the production of nitric acid from nitrogenous organic bodies, the author states that it has been generally assumed when such bodies decay in a porous medium offering a sufficiently large surface for oxidation, that nitrates must necessarily be formed. This view has, however, never been confirmed by exact experiments. In February last Schloësing and Müntz (*Comptes Rendus*, lxxxiv., 301) laid before the French Academy a paper proving, in their opinion, that nitrification was due to the action of an organised ferment. Their fundamental experiment is the following:—A glass tube, 1 metre long, was filled with a mixture of 5 kilos. of ignited sand and 100 grms. of powdered limestone. Through this mixture a slow stream of sewage filtered, so that it occupied eight days in passing down the tube. During the first twenty days no nitrates appeared in the exit-tube: after this period they could be detected. Their quantity rapidly increased, until no ammonia could be found in the exit water: this continued for four months. A small vessel of chloroform was now placed on the top of the tube, so that the vapour passed down through the soil. (This reagent effectually suspends the action of organised ferments, whilst it has but little effect on soluble ferments; *Comptes Rendus*, lxxx., 1250). In ten days all nitrates disappeared, and the ammonia salts passed through unchanged. After fifteen days the chloroform was withdrawn, but no nitrification took place during seven weeks. 10 grms. of a soil which was known to nitrify were now treated with water, and the washings poured on the column of sand so as, if possible, to seed the soil anew. Eight days after nitrates again appeared as before. The importance of this new theory is clearly very great, so the author has tested it by further experiments in two distinct lines of proof. First. The action of antiseptic vapours in preventing nitrification. Four tubes were filled with moist kitchen-garden soil. Through the first moist ammonia-free air was drawn by an aspirator. Through the second air moist as before, but previously passed through a bottle containing sponge moistened with carbolic acid. The air drawn through the third tube was similarly charged with a little bisulphide of carbon; that through the fourth with chloroform. Two series of experiments were made. At the end of the experiments the nitrates formed in the soil were determined by the method of Crum and Frankland: the results are given in the following table, the experiments lasting 39 and 46 days respectively:—

*Nitrogen as Nitrates and Nitrites per Million of Air-dried Soil.*

History of Soil.	First Experiment.	Second Experiment.
Original soil .. .. .	6.12	8.91
Air passed .. .. .	40.87	50.86
„ with carbolic acid ..	17.20	40.77
„ with carbon bisulphide	6.70	9.75
„ with chloroform .. .	9.48	7.86

The result of these experiments proves that chloroform and bisulphide of carbon effectually prevent nitrification; that carbolic acid is probably effective to the extent in

which it comes in contact with the soil. So antiseptics, as a class, are inimical to nitrification. The second line of proof investigated was the possibility of inducing nitrification by seeding with a substance already nitrifying. After several unsuccessful attempts the author succeeded in nitrifying practically the whole of an ammonium salt. Four stoppered pint bottles were taken, and nearly filled with a solution of ammonic chloride (1 c.c. = 0.000025 grm. ammonia), to which a small quantity of acid phosphate of potassium was added. Two of the bottles were seeded with about 1 grm. of surface-soil from a "fairy ring." One unseeded and one seeded bottle were kept in the light, the other two in the dark. In three months' time the seeded bottle in the dark contained abundance of nitric acid and no ammonia; the other three contained plenty of ammonia but no nitric acid. 1 c.c. of the liquid which had undergone nitrification was now added to each of the unseeded bottles, one in the light and one in the dark. 0.005 grm. of acid tartrate of potassium (to supply organic carbon) was also added to each bottle. In a month the bottle in the dark contained abundance of nitric acid; the one in the light was unnitrified. The conclusions of Schloësing and Müntz have thus been completely confirmed, with the addition of the important fact that darkness is apparently essential to the action of the nitrifying germs.

After the thanks of the meeting had been given to the author for his important communication,

Dr. GILBERT said that it now seemed strange, having the parallel of the acetic acid fermentation, that this important process had remained so long uninvestigated. In his opinion, the experiments of Schloësing and Warington left no doubt as to the correctness of their explanation of the process. Dr. Gilbert then drew attention to the great variety which has been found to exist in the power possessed by soils and plants to nitrify in different degrees. Thus one soil would nitrify four to five times as much as another under similar conditions.

Mr. HOWARD said that the value of old nitre-beds as compared with new ones had long been appreciated, but not understood. The paper of Mr. Warington afforded a satisfactory explanation of their value. He would like to ask if any substances, such as spongy platinum, besides the ferment, possessed the power of nitrification.

Mr. TIDY did not quite understand the relative action of light and darkness on the process, as the bottles exposed to the light were for such a long time—*i.e.*, during the night—in darkness.

Mr. KINGZETT enquired whether the presence of oxygen was necessary.

Dr. FRANKLAND could but express his admiration of the paper. The subject was one of the greatest importance. He would suggest that some experiments should be made to try and assist the action of these industrious, inoffensive mycodermis. For instance, an acre of soil 6 feet deep will dispose of the sewage of 3000 people, it would be very desirable to increase this nitrifying power five or even a hundredfold, and in his opinion it was quite probable that the rate might be much increased.

Mr. HARTLEY thought that the strongest evidence of the presence of an organism was the fact that the process would not go on without the presence of organic carbon.

Dr. ARMSTRONG pointed out that all known instances of the action of unorganised ferments could be resolved into simple effects of hydration; in every case there was a splitting up of a complex molecule. With organised ferments, however, a complication in structure was often produced. The absence of nitrification in the bottles exposed to light might be due to the presence of chlorophyll containing organisms.

Mr. WARINGTON, in reply, stated that it was by no means asserted that nitrification could not take place without an organism, but that for the process to go on in soil in this rapid way the presence of the organism was requisite. In answer to Mr. Tidy, he could throw no light on the fact that darkness was necessary for the process. No

attempt had been made to specially aerate the liquids in the bottles. He would not like to say, without further experiment, that the presence of organic carbon was essential for nitrification, but from analogy he should conclude that it would be necessary.

The next paper, "*On Potable Waters*," by E. J. MILLS, D.Sc., was read by Mr. PERKIN. After a consideration of the processes for determining the organic constituents of water, the author concludes that the process of Frankland and Armstrong must form the philosophical starting-point in an endeavour to solve the problems of water analysis, and refers to it exclusively throughout his paper. He first considers, in an elaborate manner, the errors incidental to this process, and compares them with those found in Gmelin in determinations brought forward as evidence of the composition of various bodies, and finds that the accuracy of the process compares favourably with that of the ordinary combustion process, and may be safely used as a basis of inference. As regards errors, the author discriminates, in blank experiments (a), the chemical error due to the introduction of sulphites, and (b) the volume error from the addition of  $n$  cubic centimetres of purified water. The size of the dish used to evaporate the water has a perceptible effect. Thus, with a 3-inch dish, the organic carbon = 0.323; organic nitrogen = 0.024. With a 6-inch dish, C = 0.307, N = 0.034, the carbon diminishing and the nitrogen increasing with the size of the dish. The author then describes a new evaporator, which consists of a cylindrical copper water-bath, with a hemispherical copper cover cooled by a flow of water. The water is contained in a 3-inch glass dish underneath the cover, and is supplied by a constant convectionless feed. A stream of purified heated air is drawn across the top of the glass dish by an aspirator. In an hour, with a current of 1062 litres, 100 c.c. will be evaporated. From a consideration of the analysis in the "Sixth Report of the Rivers' Commission" the author has arrived at three natural constants or ratios of organic carbon to organic nitrogen in potable waters—(a) 3.067,  $C_{12} \div N_3 = 3.429$ ; (b) 2.521,  $C_{12} \div N_4 = 2.571$ ; (c) 2.056,  $C_{12} \div N_5 = 2.057$ . In conclusion, the author makes some interesting suggestions as to the origin of the constancy of the composition of the air, the effect of an alteration in the mass of atmospheric oxygen, &c.

The next paper was "*On Some Derivatives of Allyl-aceton*," by J. R. CROW. The aceton was prepared according to Zeidler's method, diluted with an equal volume of ether, and transferred to a flask surrounded by cold water, and containing a volume of water twice as great as the ethereal solution. The flask was connected with a reversed condenser, and an excess of sodium gradually added. The ethereal solution was separated and distilled, after drying with potassium carbonate. After the ether had distilled over, the remaining liquid came over chiefly at 135° to 140°. After repeated fractional distillations it yielded the pure substance, boiling at 138° to 139°, having the composition  $C_6H_{12}O$ ; sp. gr. 1.842 at 16.2°. It appears to be a secondary alcohol and a homologue of allyl-alcohol. Its acetate was prepared as a colourless liquid boiling at 147° to 149°. A dibromide was also formed by the action of bromine as a slightly brown thick mass, which did not crystallise; it has the composition  $C_6H_{12}Br_2O$ .

The next communication was "*On a Fourth Method for Estimating Bismuth Volumetrically*," by M. M. P. MUIR. It has been shown by Sonchay and Lenssen (*Ann. Chem. Pharm.*, cv., 245) that normal bismuth oxalate on boiling splits up into a basic oxalate of the composition  $Bi_2O_3 \cdot 2C_2O_3 + aq$ , but slightly soluble in nitric acid. The author has utilised this reaction for estimating bismuth. An excess of saturated solution of oxalic acid is added to the solution containing bismuth, the precipitate allowed to settle, the supernatant liquid poured off, and the precipitate boiled with water until free from acid. The resi-

due is now dissolved in dilute hydrochloric acid, and titrated with permanganate. The absence of free hydrochloric acid must be secured before precipitating. The results are accurate, and the method is generally applicable.

The next paper was on "*The Gas of the Grotto del Cane*," by T. G. YOUNG. The author has analysed the gas, which contains 61.5 to 71.0 per cent of carbonic acid, the residual air having the composition—oxygen 20.25, nitrogen 79.75. Finot (*CHEM. NEWS*, vol. xxxv., p. 21) states that in the residual air there is more oxygen than in ordinary atmospheric air. The author cannot confirm this statement. The temperature of the cave in some places is as high as 40°.

The last paper was entitled "*Note on Tetrabromide of Tin*," by T. CARNELLY, D.Sc., and L. T. O'SHEA. A piece of combustion-tubing was bent in the shape of the capitals V and W joined together. In the middle bend some tin was kept melted. Bromine was dropped from a tap-funnel into one of the other bend. The metal burns in the bromine-vapour, and the tin bromide condenses in the third bend. By distillation the body was obtained pure as a colourless liquid, solidifying to a mass of colourless crystals. Melts at 30° C.; boils without decomposition at 201°; does not fume, and is very slowly decomposed in air; dissolves in cold water without immediate decomposition. It gave on analysis—Sn 27.11, Br 72.78. Its vapour-density was found to be 229.

The Society then adjourned to December 20, when the following papers will be read:—"On the Constitution of the Terpenes and of Camphor," by Dr. Armstrong; "Communications from the Laboratory of the London Institution," by Dr. Armstrong; "Hydrocarbons obtained from *Pinus sylvestris*, with some remarks on the Constitution of the Terpenes," by Dr. Tilden; "On Cuprous Chloride and the Absorption of Carbonic Oxide and Hydrochloric Acid," by J. W. Thomas; "On the Action of Reducing Agents on Potassium Permanganate," by F. Jones; "On Citric Acid as a Constituent of Unripe Mulberry Juice," by Dr. Wright and Mr. Patterson.

#### IMPERIAL ACADEMY OF SCIENCES, ST. PETERSBURG.

November, 1877.

W. WINOGRADOFF, "*Action of Brom-acetyl-bromide on Zinc-ethyl and Zinc-methyl*." The reaction proceeds slowly in the cold, 1 mol. of  $CH_2Br.COBr$  being added to 3 molecules of the zinc compounds. After a few weeks, in the case of  $Zn(CH_3)_2$ , crystals of  $ZnBrCH_3$  are formed on the addition of  $H_2O$ , and by distillation methyl-isopropyl-carbinol,  $C_5H_{12}O$ , is obtained. Zinc-ethyl yields in the same way an alcohol,  $C_8H_{18}O$ , boiling at 166°.

N. ZININ, "*Amaric Acid and its Homologues*." This acid, obtained by heating benzamorone with alcoholic potash, is found to possess the composition  $C_{46}H_{42}O_6$ . The anhydride,  $C_{46}H_{38}O_4$ , as formed on heating, melts at 140°, and can be distilled. The alkaline salts and the anhydride are decomposed by heating with HKO as follows:—



The pyro-amaric acid thus formed is almost insoluble in  $H_2O$ , melts at 94°, crystallises in prisms, and possesses an exceedingly bitter taste. By heating benzamorone in a solution of HKO in isobutyl-alcohol the author obtains isobutyl-amaric acid,  $C_{50}H_{50}O_6$ , which closely resembles amaric acid, and forms a similar anhydride, which yields with HKO the acid,  $C_{18}H_{19}O_2K$ . This fact would show pyro-amaric acid to be isomeric with dibenzyl-acetic acid,  $C_6H_4(C_2H_5)C_7H_6.COOH$ , while its homologue would be benzyl-isobutyl-benzoic acid.

## NOTICES OF BOOKS.

*Elementary Chemistry: a Text-Books for Beginners, &c.*  
By S. F. PECKHAM, A.M., Professor of Chemistry University of Minnesota. Louisville, Kentucky: J. P. Morton and Co.

THE colloquial method of conveying instruction to young learners is at least as old as Plato's Dialogues. In modern days it has been successfully adopted by Mrs. Marcet and Dr. Joyce, whose once excellent works have long become obsolete. In the little book before us the narrative form is used, each character—an uncle and his nephews and niece—speaking for himself, the conversational portions being interspersed with descriptive passages. It is, in fact, written in a style that would be most likely to attract young children. The idea, however, though an excellent one, is not always well carried out, for the children ask alternately the most babyish and the most astute questions. In addition to this, the language used by the instructing uncle is frequently such as would puzzle children of a larger growth, although generally speaking its colloquial plainness is to be admired. Another good feature is that the children are often represented as performing the experiments for themselves, although not as frequently as could be wished, seeing that the illustrations are generally of the simplest possible character. In the first part the non-metallic elements are described, Part II. being devoted to the metals, while Part III. treats of vegetable and animal chemistry as applied to physiology and agriculture. The chapters on vegetable physiology and agricultural chemistry are particularly good.

While upon this subject we may perhaps be excused if we take the opportunity of saying a few words upon the present state of elementary scientific instruction. During the last ten years a large number of excellent scientific school books have been issued, but they are all intended for the instruction of boys and girls of twelve or thirteen, or upwards, while the younger children have been left out in the cold. The speech of Sir John Lubbock at Bradford shows that at last educationists are awakening to the necessity of providing scientific instruction for children of tender years. At the various meetings of the Royal Commission on Scientific Instruction Professor Tyndall repeatedly endeavoured to instil into the minds of his colleagues the necessity for beginning a child's scientific training at as early an age as possible, but his words fell flat on his hearers, who looked upon them as the utterances of an amiable enthusiast. Judging by Prof. Peckham's work and Sir John Lubbock's speech it would seem that the good seed had at last begun to germinate. The only pabulum at present administered to young children, which at all resembles scientific instruction, is what is called "Object Lessons." A lump of sugar, for instance, is held up before the children, who name its different qualities. The teacher then describes its origin and manufacture, and the children repeat all that they recollect of the matter simultaneously in a sing-song tone. The manuals for teaching these lessons are always lacking in arrangement, the lessons having neither connection nor sequence. On one day a lesson is given on a fly, the next on Gloucestershire, the third on a piece of black-lead, and the fourth on a feather. The information conveyed is generally obsolete or incorrect. In a manual published within the last year or two black-lead is described as an ore of iron, Nevada is ignored as a silver-producing country, paraffin and petroleum are not even mentioned in the lesson on lamps and candles, and waterproof garments are said to be imported from Quito!

It may be objected that children of from six to twelve are incapable of making experiments and of drawing conclusions from them, but this fact is always forgotten, that the first years of a child's life are a series of experiments from which he draws his own conclusions and acts upon them. Any intelligent boy or girl who can spin a top, thread a needle, bowl a hoop, or fell a seam, can, by judi-

cious suggestions, be led to discover such facts as that the sun warms us, and that the moon does not; that a suspended magnet points to the north; that iron becomes covered with black rust in the fire and with yellow rust in the damp air, and a hundred other facts that they may make their own through the spontaneous exercise of their proper faculties. A child who, by proper questioning and suggestion, has been led to find out for himself that a magnet has two poles possessing different properties has discovered something that is more valuable to him than the mere scientific fact—he has found out that he can teach himself without the intervention of books and teachers.

We cordially welcome Professor Peckham's little book as being the first step in the right direction, although it has a few defects and shortcomings.

*Outlines of Modern Organic Chemistry.* By C. GILBERT WHEELER, Professor of Chemistry in the University of Chicago. A. S. Barnes and Co., New York and Chicago, 1877.

THIS is a handy little manual for those students who have already gone through a course of mineral chemistry, and wish to make themselves acquainted with the chemistry of organic compounds. The author very modestly lays no claim to originality, and freely acknowledges his indebtedness to the works of Riche, Miller, Fownes, and other well-known writers. From what the author says in his preface it would appear that organic chemistry has not as yet received in American colleges sufficiently pronounced attention to create a demand for text-books of considerable size or extended scope; he has therefore confined his labours within the narrow limits of some 200 pages. The practical American mind never seems to have taken kindly to the chemistry of carbon compounds, and chemists on the other side of the Atlantic prefer the more definite and simple results to be obtained by the analysis and synthesis of mineral compounds. In *Silliman's Journal*, for instance, the researches in mineral chemistry far outnumber those in organic chemistry proper, and the same may be said of the extracted articles and papers. It is not, therefore, surprising that the American chemists who have made a reputation as workers in the organic branches of chemical science may be counted on the fingers of one hand. The book is clearly and concisely written, but is somewhat disfigured by the lax method of terminology adopted by Professor Wheeler. For instance, in the article on the  $C_6H_6$  series of compounds the word benzine is used indifferently with benzol, although we are afterwards told that the benzine of commerce is not benzol at all, but something else. The homologues of benzol, too, are spoken of as toluene, xylene, &c. Again, when we come to the artificial and natural alkaloids, some of the names end in "ia," others in "ine," and a few in "ina." Such changes as these are apt to be productive of sick head-aches in stupid students, whose infirmities are hardly sufficiently considered by the writers of elementary books. The pyridine series of alkaloids is omitted altogether, although they have a peculiar interest attached to them as being metameric with the phenylamine series. The same remark applies to the quinoline series. These, however, are but slight blemishes in an otherwise admirable little manual.

## CORRESPONDENCE.

### DAVY'S METHOD OF EXAMINING FOR ARSENIC.

*To the Editor of the Chemical News.*

SIR,—I have made the following experiments to test the delicacy of Davy's method of examining for arsenic. I took 0.05 grm. of dry arsenious acid, and dissolved it in

1 litre of water, and made the more dilute solutions from this. 1 c.c. of solution was used in each test:—

	Solutions.	Results.
(a.) 0.00005	gram. $\text{AsO}_3$ to 1 c.c.	{ Strong stain in half a minute.
(b.) 0.00001	" "	{ Ditto in 2 minutes.
(c.) 0.000005	" "	{ Stain in 2 to 3 mins.
(d.) 0.0000025	" "	{ Doubtful in 15 mins.
(e.) 0.000001	" "	{ Manifest in 60 mins.
(f.) 0.0000005	" "	{ Full stain in 12 hours.
(g.) 0.00000025	" "	{ Manifest in 1½ hours.
		{ Faint, but decided stain in 1 hour.

Experiment (e.) necessarily stood overnight. From these results it would seem that Davy's test will indicate with certainty an amount of arsenious acid as small as one-quarter of a millionth of a gramme, and I do not think this is the lowest limit.—I am, &c.,

J. M. MERRICK.

59, Broad Street, Boston, U.S.A.,  
November 21, 1877.

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 22, November 26, 1877.

**Nature of the Hydrocarbons Produced by the Action of Acids upon Manganiferous Specular White Cast-Iron.**—M. S. Cloëz.—The treatment of a white cast-iron containing 0.04 of combined carbon, and about 0.06 of manganese, with hydrochloric acid of sp. gr. 1.12, occasions the formation of gaseous and liquid hydrocarbons, homologues of ethylen, absorbable in bromine, and capable of combining readily with hydrochloric acid. There are also produced formenic compounds insoluble in and not attacked by sulphuric acid. To prevent the ethylenic carbides from combining with hydrochloric acid it is best to treat the cast-iron with sulphuric acid, mixing 1 part of acid at 66° B. with 5 parts of water. A gentle heat may be applied to promote the action. On treating in this manner 200 kilos. of cast-iron the author obtained 640 grms. of oily carbides, condensed in the first washing-bottles; 2780 grms. of bromated ethylenic products; 532 grms. of formenic hydrocarbides isolated by the action of sulphuric acid; 3800 grms. of insoluble residue, supposed to be dry; and, lastly, 408 grms. of oily products extracted from the insoluble residue by alcohol, and separated from the latter by water. The formenic hydrocarbides, which the author describes in the present paper, after purification were submitted to fractionated distillation. The first products went over at 155°, and the temperature rose rapidly to 160°, where it remained for a time stationary. All that passed over below 170° was kept separate, as also the portion volatilised between 175° and 190°, and thus from 20° to beyond 300°. By repeated and delicate fractionations seven distinct products were obtained, with constant boiling-points, and with corresponding chemical and physical properties. All these products are already known, and appear identical with some of those extracted from the petroleum oils by MM. Pelouze and Cahours. They are the highest terms of the formenic series. The first hydrocarbide is the hydride of decyle,  $\text{C}_{20}\text{H}_{22}$ , boiling between 155° and 160°. The second, found in small quantity, is the hydride of undecyl,  $\text{C}_{22}\text{H}_{24}$ , boiling between 178° and 180°. The remainder are the hydrides of duodecyl, of tri-decyl, of tetra-decyl, of penta-decyl, and of hexa-decyl. The identity of these complex carbides, obtained by the reaction of mineral compounds without the inter-

vention of any life, supports the opinion of certain geologists relative to the origin of the petroleum oils. From a purely chemical point of view, with reference to the synthesis of so-called organic bodies, the reproduction of a great number of these species may be effected from setting out from the ethylenic or formenic hydrocarbides yielded by cast-iron.

**Second Note on the Magnetisation of Tubes of Steel.**—J. M. Gaugain.—The variations of magnetism produced under the influence of heat in a solid bar of steel do not differ from those produced under the same influence in a system composed of a tube and a nucleus. Both appear to depend on the inverse magnetism developed by the mutual reaction of the concentric layers, whether of the bar or of the system.

**Liquefaction of the Binoxide of Nitrogen.**—M. Cailletet.—The author has succeeded in liquefying this gas by the pressure of 104 atmospheres at  $-11^\circ$ . At  $+8^\circ$  the binoxide remains gaseous at a pressure of 270 atmospheres. Pure formen compressed by 180 atmospheres at  $7^\circ$  (+ or - ?) gives rise, when the pressure is suddenly reduced, to a mist, like that which appears when the pressure upon liquid carbonic acid is suddenly diminished. This fact gives the author hopes of effecting the liquefaction of formen. M. Berthelot, in presenting the above communication, called attention to the discovery of Mr. Andrews that there exists for every vapour a critical point of temperature, above which liquefaction cannot be produced by any pressure soever. This critical point, for the binoxide of nitrogen, appears to lie between  $+8^\circ$  and  $-11^\circ$ .

**Nitrification by Organic Ferments.**—MM. Th. Schlöesing and A. Muntz.—In the authors' experiments, whenever a nitrifiable medium remains in presence of chloroform, or has been heated to  $100^\circ$ , and then preserved from atmospheric dust, nitrification has been suspended. But it can be re-animated by introducing into the heated medium a small quantity of a substance such as earth, in which nitrification is active.

**Modification of Bell's Telephone with Multiple Membranes.**—M. Trouvé.—The author states that the apparatus of Mr. Bell, on ordinary lines, only transmits the voice to relatively short distances in consequence of the weakness of the currents produced by the manipulator. He therefore substitutes for the single membrane of Bell's telephone a cubic chamber, of which each surface, with the exception of one, is formed by a vibrating membrane. Each of these membranes, thrown into vibration by the same sound, acts upon a fixed magnet fitted with an electric circuit. In this manner, by associating all the currents produced by these magnets, there is obtained a single intensity, which increases in proportion to the number of the magnets influenced. For the cube we may substitute a polyhedron, the faces of which are formed of an indefinite number of vibrating membranes, in order to obtain the desired intensity.

*Justus Liebig's Annalen der Chemie,*  
Band 189, Heft 3.

**A Contribution to the Knowledge of the Iron-Cyanogen Compounds.**—Dr. Z. H. Skraup (Second treatise).—The author describes super-ferrid-cyan-potassium,  $\text{FeCy}_6\text{K}_2$ , identical with Bong's black prussiate, and obtained by the action of potassium chlorate and hydrochloric acid upon potassium ferrid-cyanide. If heated with nitric acid it is converted into potassium nitroprusside. With the salts of barium, strontium, calcium, and aluminium solutions of super-ferrid-cyan-potassium give no precipitates; neutral salts of lead give no precipitate, but take a peculiar blue colour; sugar of lead gives an abundant green precipitate, resembling hydrated chromic oxide; silver nitrate produces a dirty green precipitation, which turns yellow on standing, more rapidly if boiled, and finally turns white, but very slowly; coppe-

and nickel are precipitated olive-green; cadmium and manganese, a grey-violet; zinc, a greyish blue; cobalt, a red-brown. Ferric salts give no precipitate, but merely an olive-green colour; ferrous salts produce a characteristic blue-green precipitate. The super-ferrid-cyan-potassium can only be obtained pure in an amorphous condition. Bong's crystallised black prussiate was probably contaminated with potassium sulphate.

## MISCELLANEOUS.

**Royal Society.**—On St. Andrew's Day the Anniversary Meeting of the Royal Society was held. The following officers were elected for the ensuing year:—President, Sir J. D. Hooker, C.B., M.D., D.C.L., LL.D. Treasurer, W. Spottiswoode, M.A., LL.D. Secretaries, Prof. G. G. Stokes, M.A., D.C.L., LL.D.; Prof. T. H. Huxley, LL.D. Foreign Secretary, Prof. A. W. Williamson, Ph.D. Other Members of the Council, F. A. Abel, C.B., V.P.C.S.; W. Bowman, F.R.C.S.; F. J. Bramwell, M.I.C.E.; W. B. Carpenter, C.B., M.D., D.C.L.; W. Carruthers, F.L.S.; W. Crookes, V.P.C.S.; Prof. P. M. Duncan, M.B., P.G.S.; W. Farr, M.D., D.C.L.; Prof. W. H. Flower, F.R.C.S.; Prof. G. C. Foster, B.A., F.C.S.; J. R. Hind, F.R.A.S.; Lord Rayleigh, M.A.; Vice-Admiral Sir G. H. Richards, C.B.; Prof. H. J. S. Smith, M.A.; Prof. B. Stewart, M.A., LL.D.; Prof. A. Thomson, M.D., F.R.S.E. The Copley Medal was awarded to Prof. Dana; the Royal Medals to Profs. Abel and Heer. The Davy Medal was awarded to Profs. Bunsen and Kirchhoff.

**University of London.**—The following is a list of the candidates who have passed the recent Second B.A. and Second B.Sc. Examinations:—Examinations for Honours, B.A. and B.Sc. conjointly; Logic and Moral Philosophy. First class—J. G. Schurman, B.A., University College, disqualified by age for Scholarship; W. A. Statham, B.A., University College, Scholarship; A. J. Harvey, B.A., University College. Second class—H. W. Trenchard, B.A., University College; L. Cohen, B.A., Jews' Free School; W. J. Spratling, B.Sc., University College and private study. Third class—N. J. Synnot, B.A., Catholic University College, Kensington; C. E. Davis, B.A., private study; C. Warburton, B.A., Old Trafford School and private study; J. Easterbrook, B.A., St. Mark's College, Chelsea. B.Sc. only; Chemistry. Second class—W. L. Wills, Owens College; E. H. Cook, Royal College of Science, Dublin; J. H. Paul, private study. Experimental

Physics. Second class—W. L. Wills, Owens College. Third class—E. H. Cook, Royal College of Science, Dublin. Physical Geography and Geology. Second class—A. Simpson, B.A., F. C. Divinity Hall, Aberdeen; A. C. Dixon, private study; W. J. Spratling, University College and private study. Botany. Second class—R. H. S. Spicer, St. Mary's Hospital.

**Edinburgh University Chemical Society.**—The fourth Annual Meeting of this Society was held on Wednesday, the 28th ult., when the President, Prof. Crum Brown, delivered an address on "The Life and Works of Joseph Black." During last winter session fifteen papers were read at the meetings of the Society, and during the summer session five excursions were made to chemical works. Office bearers for the present year:—President, Prof. A. Crum Brown; Vice-Presidents, W. Inglis Clark, B.Sc., John Gibson, Ph.D., F.R.S.E.; Hon. Treasurer, Charles Maxwell, R.N.; Hon. Secretary, John Adams. This Society has now 52 members on its register, and ten new names were proposed at the last meeting for membership. During the last three winter sessions upwards of thirty papers have been read before the Society, and during the corresponding summer sessions fifteen different chemical works, or other works of interest to chemists, have been visited.

## MEETINGS FOR THE WEEK.

SATURDAY, Dec. 15th.—Physical, 3.

MONDAY, Dec. 17th.—Society of Arts, 8. Cantor Lecture. "Manufacture of Paper," Lecture III., W. Arnot, F.C.S.

TUESDAY, 18th.—Manchester Geological Society, 3.

WEDNESDAY, 19th.—Society of Arts, 8. "The Telephone," by Prof. A. Graham Bell.

THURSDAY, 20th.—Meteorological 7.

Chemical, 8. "On the Constitution of the Terpenes and of Camphor," Dr. Armstrong. "Communications from the Laboratory of the London Institution," Dr. Armstrong. "Hydrocarbons obtained from *Pinus Sylvestris*, with some remarks on the Constitution of the Terpenes," Dr. Tilden. "On Cuprous Chloride, and the Absorption of Carbonic Oxide and Hydrochloric Acid," J. W. Thomas. "On the Action of Reducing Agents on Potassium Permanganate," F. Jones. "On Citric Acid as a Constituent of Unripe Mulberry Juice," Dr. Wright and Mr. Patterson.

## TO CORRESPONDENTS.

Sheffield.—Fresenius's "Qualitative and Quantitative Analysis."

## COMPOSITION AND QUALITY OF THE METROPOLITAN WATER.

NOVEMBER, 1877.

The following are the returns of the Society of Medical Officers of Health:—

Appearance in 2 foot Tube.	Ammonia.		Nitrogen as Nitrates, &c.	Oxygen used to Oxidise Organic Matter.	Total Solids.	Lime.	Magnesia.	Chlorine.	Sulphuric Anhydride.	Hardness on Clark's Scale.	
	Saline.	Organic.								Before Boiling.	After Boiling.
	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Grs.	Degs.	Degs.
<i>Thames Water Companies.</i>											
Grand Junction .. ..	Clear	0'000	0'007	0'156	0'046	21'10	8'560	0'430	0'94	1'400	14'8 3'00
West Middlesex .. ..	Clear	0'001	0'008	0'160	0'042	19'40	8'340	0'390	1'01	1'230	15'3 4'20
Southwark and Vauxhall	Clear	0'000	0'008	0'100	0'053	20'50	8'340	0'360	0'94	1'130	13'7 3'30
Chelsea .. ..	Clear	0'001	0'008	0'110	0'042	17'90	7'670	0'430	0'94	1'230	13'2 2'80
Lambeth .. ..	Clear	0'000	0'009	0'133	0'053	20'60	9'180	0'390	0'94	1'560	14'3 2'80
<i>Other Companies.</i>											
Kent .. ..	Clear	0'000	0'002	0'366	0'003	27'30	11'200	0'610	1'37	4'000	19'4 5'10
New River .. ..	Clear	0'000	0'006	0'100	0'050	20'50	9'070	0'320	0'94	0'800	14'0 2'40
East London .. ..	Clear	0'001	0'007	0'110	0'032	19'80	8'450	0'360	1'08	1'230	15'4 2'80

The quantities of the several constituents are stated in grains per imperial gallon.

NOTE.—The amount of oxygen required to oxidise the organic matter, nitrites, &c., is determined by a standard solution of permanganate of potash acting for three hours; and in the case of the Metropolitan waters the quantity of organic matter is about eight times the amount of oxygen required by it

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Professor TYNDALL, D.C.L., F.R.S.—Six Lectures adapted to a Juvenile Auditory, on Heat, Visible and Invisible; on Dec. 27 (Thursday), 29, 1877; Jan. 1, 3, 5, 8, 1878.

Professor ALFRED H. GARROD, M.A., F.R.S.—Twelve Lectures on the Protoplasmic Theory of Life and its Bearing on Physiology; on Tuesdays, Jan. 22 to April 9.

JAMES D. WAR, Esq., M.A., F.R.S.—Twelve Lectures on the Chemistry of the Organic World; on Thursdays, Jan. 24 to April 11.

R. BOSWORTH SMITH, Esq., M.A.—Seven Lectures on Carthage and the Carthaginians; on Saturdays, Jan. 26 to March 9.

Rev. W. HOUGHTON.—Three Lectures on the Natural History of the Ancients; on Saturdays, March 16, 23, 30.

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The Friday Evening Meetings will begin on January 25th, at 8 p.m., when Professor Tyndall will give a Discourse at 9 p.m. Succeeding Discourses will probably be given by W. H. Preece, Esq.; Matthew Arnold, Esq.; Dr. Philip L. Sclater; Professor Roscoe; Dr. R. Liebreich; Professor Goldwin Smith; Lord Rayleigh; Professors Huxley and Dewar; Sir John Lubbock; and Sir Joseph D. Hooker. To these Meetings Members and their Friends only are admitted.

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# THE CHEMICAL NEWS.

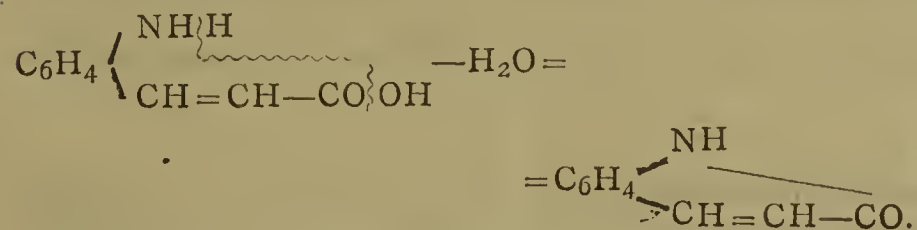
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## ON SOME DERIVATIVES OF ORTHO-NITRO-CINNAMIC ACID.

By THOMAS M. MORGAN.

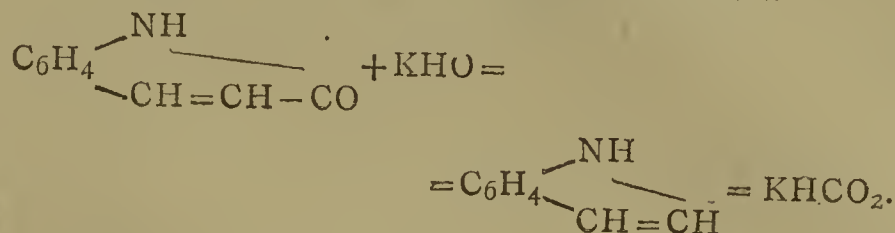
It is some years since Baeyer showed how ortho-nitro-cinnamic acid might be made to yield a small quantity of indol—a discovery of much interest to chemists, since indol is a reduction-product of indigo. This latter substance, when boiled with caustic soda, yields anthranilic acid, and, when fused with the same, salicylic acid, from which it may be inferred that indigo belongs to the ortho series, and that the aromatic nucleus has only one side chain: the molecule also contains eight, or a multiple of eight, carbon atoms. As the connection, therefore, between the derivatives of indigo and the ortho substitution-products of cinnamic acid does not appear remote, I thought an investigation of the latter might lead to interesting results.

When the cinnamic acid had been nitrated the ortho was separated from the para, by suspending in alcohol and leading hydrochloric acid gas into the mixture: the alcohol grows warm, and the ethers as they form dissolve; but as the solution cools the para ether almost completely separates, and on filtering and distilling a residue is obtained consisting of ethyl-ortho-nitro-cinnamate. On digesting the latter with alcoholic ammonium sulphide, there is produced, along with much resinous matter, a crystalline substance which has received the name of carbostyrol. I find, also, that the free acid yields the same product on reduction with tin and hydrochloric acid. carbostyrol has the composition of amido-cinnamic acid minus water; it is deposited in large brilliant prisms by slow evaporation of its alcoholic solution: these melt at 199° to 200°, dissolve in hydrochloric acid, and also in caustic soda, but from the first solution, ether again extracts the substance, and from the second carbon dioxide precipitates it. This weak affinity for acids and bases is explained by supposing that the separation of water from amido-cinnamic acid takes place in the way the following formulæ indicate:—



It has been observed by Chiozza that when carbostyrol is heated with solid potash an oily alkaloid is produced, to which ("Watts's Dictionary," vol. i., p. 802) the formula  $\text{C}_8\text{H}_7\text{N}$  has been imputed. On repeating the experiment I obtained from the oil the characteristic reactions of indol, but the quantity formed is small. It is more advantageous to use soda-lime; but even with this, and using 6 grms. of carbostyrol (all I had left), I could only recognise indol in the distillate by qualitative tests. The mixture was heated in a glass tube to a temperature short of redness, much hydrogen was evolved, and the oily distillate contained aniline and indol: it was rendered slightly acid, and again distilled with water; the aqueous distillate was milky, gave a red precipitate with nitric containing nitrous acid, and pine wood moistened with hydrochloric acid was stained red, changing afterwards to brown; when extracted with ether there was left, on evaporation of the ether, an oil of a peculiar disagreeable odour, which, when heated with a little water, solidified

on cooling, and re-melted on again gently warming. These were all the tests that I applied. Carbostyrol is thus resolved, by heating with an alkali, into a formate and indol, a decomposition readily understood if we suppose Baeyer's formula for the latter to be correct.



The yield is necessarily small, as at the high temperature only a small part of the indol escapes decomposition.

### Ortho-amido-phenyl-glyceric Acid.

By the process already described for separating ortho from para-nitro-cinnamic acid, there is, besides the two ethers, at least one other body formed. I have not attempted its isolation at this stage, as it first came under my notice after reduction of the ethers with tin and hydrochloric acid, when, upon addition of common ether, some of it was extracted, and imparted to the ether a beautiful green fluorescence. The fluorescent substance was isolated in this manner. The nitro-acids were regenerated from their ethers and reduced with tin and hydrochloric acid: the mixture was repeatedly extracted with ether, and the tin, which for the most part passes into the ethereal solution, was precipitated therefrom with zinc, and the latter was washed out with water. The ether was next distilled, and the residue dissolved in caustic soda; the solution was saturated with carbon dioxide, so as to precipitate carbostyrol, filtered, and evaporated to dryness. On extraction with alcohol a sodium salt dissolved; it crystallised readily from alcohol, and was by this means purified. An aqueous solution of the sodium salt, on treatment with hydrochloric acid, gives first a yellow precipitate, which an excess of the acid redissolves: the yellow precipitate dissolves freely in hot alcohol, and separates in yellow needles as the solution cools. An analysis was made by taking 7 centigrams of the substance and heating in a vacuum tube to faint redness, with a known quantity (about six times the weight) of a known mixture of chlorate of potash and manganese dioxide (about 2 per cent of the latter), as it is difficult to effect the complete decomposition of pure chlorate of potash in a sealed glass tube at a dull red-heat. A eudiometric analysis of the gases gave the following numbers:—

Calculated for	
$\text{C}_6\text{H}_4\text{NH}_2\text{CHOHCHOHCOOH}$ .	
C 54.9	C 54.9
O 32.3	O 32.5
N 7.0	N 7.1
H 5.8	H 5.5

When used with caustic potash, ammonia was evolved and two acids were produced: the silver salt of the one yielded 64.7 per cent of silver, and it was therefore acetic acid; the sodium salt of the other gave with ferric chloride a violet colour, identical—as was proved by direct comparison—with that produced by sodium salicylate. The substance may therefore be regarded as aniline in which a hydrogen atom in the ortho position has been replaced by a residue of glyceric acid, and may be called ortho-amido-phenyl-glyceric acid. It appears to combine with hydrochloric acid, as the gas passed over the yellow crystals turns them white, and the white compound is insoluble in ether, and may be re-crystallised from a hydrochloric acid solution; but on heating with water a yellow solution is obtained which deposits yellow crystals, identical with the original, on cooling. It melts at 218° with partial decomposition, and sublimes by careful heating; readily dissolves in alcohol, ether, chloroform, and benzene; it is very sparingly soluble in cold water. Its solutions all

possess a green fluorescence, a property also possessed by solutions of ortho-coumaric acid; and the two substances have in their molecular structure considerable resemblance. Of its salts the barium, potassium, and sodium ones were prepared; the first deposits from a hot saturated solution in yellow crystals; the other two are nearly, if not quite, colourless, very soluble in water, but crystallising readily from alcohol. The salts with acids were not examined.

In trying to account for the formation of the substance I have supposed that nitro-phenyl-dichlor-propionic acid first arises from an oxidation of the hydrochloric acid, led into the nitro acids suspended in alcohol, and then—by reacting with water or alcohol—nitro-phenyl-glyceric acid is produced, and this by reduction yields the amido compound.

I hope to be in possession of more material shortly for the further prosecution of this research.

Victoria College, Jersey.

## THE DERIVATIVES OF BENZENE.

By P. T. MAIN.

(Continued from p 262.)

IN a previous paper it has been shown how the di-, tri-, or tetra-derivatives of benzene may each be distinguished as

belonging to one of three varieties, (1), (2), and (3), the

significance of these distinguishing numbers being evident from Propositions I., II., and III. in the case in which the hydrogens of benzene are throughout replaced by the same element (or group), *e.g.*, by chlorine.

In the cases in which the hydrogens of benzene are *not* both replaced by the *same* element or group, there are of the di-derivatives only three isomers, one of each of the

three varieties (1), (2), and (3); but of tri- or of tetra-

derivatives there may be more than three isomers, there being, in fact, two or more isomers of each variety.

The notation, (1), (2), (3), which I propose, is easily

applicable to distinguishing all these cases of isomerism. Before illustrating, by one or two examples, how this may be done, it will be desirable to make the following definitions:—

*Def.*—One di-derivative of benzene is said to *represent* (or be represented by, or be a representative of) another, when either may be converted into the other, or both into a third, by simply varying (through substitution) the replacing element or group.

*Def.*—A di-derivative and a tri-derivative are said to be *related* to one another, when the tri-derivative (or a representative of it) may be obtained from the di-derivative by replacing one of the remaining benzene-hydrogens of it by an element or group; or when the di-derivative (or a representative of it) may be obtained from the tri-derivative by substituting hydrogen for one of the replacing elements or groups.

When a tri-derivative is related to a (1), (2), or (3) di-derivative by the replacement of its substituted elements or groups by hydrogen, this is conveniently indicated by placing (1), (2), or (3), as the case may be, over that element or group.

Similarly for the relation of a tetra-derivative to tri-derivatives.

*Ex.*—As an example, *resorcin* has been shown to be related

(1) (2) (3) (1) (2) (3)  
to nitro-nitro-methyl-benzene, or to  $C_6H_3.NO_2.NO_2.CH_3$ ; which compound is thus indicated as being related to all three varieties (1), (2), and (3) of di-derivative (and to be, therefore, a (3) tri-derivative); to a (1) or (2) nitro-methyl-benzene by replacement of one or other  $NO_2$  by H, and to a (3) di-nitro-benzene by replacement of  $CH_3$  by H.

The constitution of this di-nitro-methyl-benzene was proved thus:—By nitrating toluene two nitro-methyl-benzenes are obtained, which are shown to be the (1) and the (2) nitro-methyl-benzene; one and the same di-nitro-methyl-benzene can be got from both these nitro-methyl-benzenes. This shows that the dinitro-methyl-benzene is related to a (1) di-derivative by the replacement of one of its  $NO_2$  groups by H, and to a (2) di-derivative by replacement of the other  $NO_2$ . It is therefore a

(1) (2)  
nitro-nitro-methyl-benzene; and it only remains to find which variety of di-derivative is given by the replacement of  $CH_3$  by H. This is shown to be the (3) variety thus; the nitro-nitro-methyl-benzene has been shown to be related to a (1) di-derivative, viz., (1) nitro-methyl-benzene; but a (1) di-derivative is related to one variety only, the (3), of tri-derivative; hence the nitro-nitro-methyl-benzene is a (3) tri-derivative. But a (3) tri-derivative is related to *all three* varieties (1), (2), and (3) of di-derivative; therefore the replacement of  $CH_3$  by H gives a (3) di-derivative. Hence this compound is

(1) (2) (3)  
nitro-nitro-methyl-benzene, and its constitution is completely determined. By reduction of this compound methyl is replaced by hydrogen, and thus a (3) di-amido-benzene is formed, which is represented by a di-nitro-benzene from which *resorcin* can be got; and thus *resorcin* is shown to be a (3) di-derivative.

It is, perhaps, necessary to remind the reader of the sense to be attached to the (1), (2), (3) when written over substituted elements or groups, and to warn him that they have nothing whatever to do with the numbering 1, 2, 3, 4, 5, 6 of the corners of the benzene hexagon.

The following example is simpler than the above. It is a problem which was solved by Walker and Zincke:—

*Problem.*—The (2) and (3) nitro-bromo-benzene when

nitrated give a dinitro-bromo-benzene: is this a (1), (2), or (3) tri-derivative? Since it is related both to a (2) and a (3) di-derivative by replacing in them H by

(2) (3)

NO<sub>2</sub> it is nitro-nitro-bromo-benzene; it remains to find what variety of di-derivative is got by replacing Br by H.

By a reaction involving this replacement a (1) di-derivative was obtained, viz., (1) di-amido-benzene: thus the

(2) (3) (1)

compound is nitro-nitro-bromo-benzene.

The notation I have used might be replaced, without alteration of the method, by the notation (1), (2), (3); or *a*, *b*, *c*; *α*, *β*, *γ*; or 1, 2, 3. The last-mentioned would no doubt be best, were it not for the inevitable confusion with the numbering of the corners of the benzene-ring.

# ON THE ANALYSIS OF VANADIUM SULPHATES AND THEIR DOUBLE SALTS WITH ALKALINE SULPHATES.

By Dr. B. W. GERLAND.

CHEMICAL literature offers but very scanty assistance for the separation and estimation of vanadium, and the few statements made are not always trustworthy. The description of the method I have, after much experience, adopted for this class of vanadium compounds, as the most reliable and expeditious, may under these circumstances be of some interest and service, particularly as the most important part will be generally applicable for all vanadium compounds. Several of the substances I intend to describe in future papers could not be obtained in a pure state, or were too easily affected by oxygen or moisture to allow their trituration and the preparation of a uniform mixture for analysis: it is in such cases necessary to estimate in one sample the greatest possible number of constituents. The task is thereby made more troublesome, and it will be advantageous, when the uniformity of the substance admits, to weigh out several quantities for different determinations.

For the estimation of sulphuric acid, vanadium, and alkalies, the weighed sample is dissolved in water, according to circumstances, with the aid of nitric acid or ammonia, or both. After cooling, the clear solution is acidulated with nitric acid, mixed with lead acetate and alcohol, until all sulphuric acid is precipitated. After a few hours rest, when the lead sulphate has settled, it is filtered and washed with dilute alcohol. No difficulty is experienced if the vanadium is present as tetroxide, but with the pentoxide it often happens that lead vanadate is mixed with the sulphate, and is recognisable by the intense yellow colour of the latter. In that case only the clear liquor is poured off and passed through a small filter, the precipitate treated with a little nitric acid, if necessary heated in a water-bath, then mixed with water and afterwards with alcohol, and allowed to stand for a few hours. The vanadate is generally dissolved by this treatment, and the lead sulphate appears perfectly white; it is now thrown on the same filter, and treated as before. But it does happen, particularly when the precipitation has taken place at a higher temperature, that the sulphate still retains a small amount of vanadate. I have recognised in the ammonium carbonate the most efficient means for sepa-

rating this small residuum. The solution of this reagent scarcely acts upon the pure lead vanadate; but if the latter is mixed with lead sulphate the former is left intact, whilst the sulphate is rapidly converted into lead carbonate. The solution therefore contains all the sulphuric acid, and only inappreciable traces of vanadium; it is treated with barium chloride in the usual way, and the barium sulphate weighed. The insoluble part, after washing, is heated with acetic acid to dissolve the lead carbonate, and the remaining vanadate is thrown upon the filter already used, washed, and united to the main vanadium precipitate.

The solution from the lead sulphate is neutralised with ammonia, acidulated with acetic acid, and precipitated with lead acetate in small excess. If vanadium tetroxide is present, as shown by the dark colour of the precipitate, it is necessary to oxidise it, and this is readily effected by the addition of bromine water. The precipitate will now be of a bright orange or yellow colour, and very bulky; but heating, assisted by agitation, causes it to contract to a heavy curdy mass. In this condition it can be easily filtered and washed, on a Bunsen's filter, under low pressure. It is of advantage to add a small amount of lead acetate to the wash water. The precipitate is dissolved in nitric acid, the solution treated with sulphuric acid and alcohol, and after a few hours rest separated from the lead sulphate, which after washing is free from vanadium, as Roscoe has already pointed out. The filtrate containing the vanadium is evaporated in a porcelain basin, at a very low temperature (the water-bath at boiling-heat would cause a very lively evolution of gas, and loss, particularly when sulphuric acid was added in great excess), the residuum transferred to a platinum dish, again evaporated, and the sulphuric acid driven off by a careful raising of the heat. All the sulphates of vanadium (those of the trioxide, tetroxide, and pentoxide) leave vanad-pentoxide at red-heat. But this is readily reduced at that temperature by dust, and even by the gases from the lamp: it is therefore necessary to cover the capsule well, and prevent the access of fire-gases, which is best accomplished by the use of a Rose's tube. The heat is then increased to a bright red, which again causes an evolution of gas and leaves a pure pentoxide, whose weight is taken. (If the vanadium sulphates are decomposed at a dark red-heat, until gas-bubbles cease to appear, the pentoxide gives off gas again, when the heat is raised and loses weight amounting to ca. 0.5 per cent.) The platinum vessel suffers in shape by this operation. A dish which I have used very often had originally a flat bottom, but now the latter is pressed out by the vanadium pentoxide, so that the form is hemispherical, and at least 3 m.m. deeper.

The filtrate from the lead vanadate contains, besides the alkalies, a small amount of vanadium. Vanad solutions behave, as I have ascertained, similarly to those of cobalt under the influence of sulphuretted hydrogen; a dilute acetic solution with small excess of free acid, particularly in presence of an alkaline acetate, is slowly acted upon by that gas, and the vanadium precipitated as vanadyl sulphide. If the filtrate therefore is treated with sulphuretted hydrogen, according to Roscoe's direction, the vanadium which it contains will be separated with the lead sulphide: it is on that account preferable to use sulphuric acid and alcohol for the elimination of the lead. The filtrate from this lead sulphate is evaporated, and the residuum heated until the ammonium salts are driven off. The remaining alkalies are dissolved, treated with acetic acid, and once more submitted to the described process for the separation of the small quantity of vanadium with lead acetate. The filtrate from this lead vanadate precipitate is most expeditiously treated with ammonia and sulphide of ammonium at boiling-heat, and the solution separated from the lead sulphide is worked up for the estimation of the alkalies.

*The Estimation of Water.*—The use of lead oxide, particularly for those compounds which do not allow of intimate mixture, offers great difficulties; even an incon-

veniently long column was not sufficient to retain the large quantities of sulphur dioxide and trioxide that were evolved. I have used with advantage sodium carbonate, obtained as a very light powder, by heating the acid carbonate to about  $300^{\circ}$ . From 5 to 10 grms. of this very light powder, in a combustion-tube of 30 c.m. length, are sufficient in every case. When the lower sulphates ( $V_2SO_4$ ,  $V_2H_{24}SO_4 \cdot 2H_2O$ , &c.) are to be treated in this way it is advisable to mix the sodium carbonate with potassium chlorate, to prevent sublimation of sulphur. The front of the combustion-tube is supplied with a good plug of asbestos, to avoid the carrying forward of dust into the chloride of calcium tube. The apparatus having been mounted, the whole length of the combustion-tube is warmed, to prevent condensation of water; then the part where the mixture of substance and soda lies is heated to redness, and by degrees the heating is extended all over the tube.

*The Estimation of Vanadium by Titration with Permanganate.*—The first condition is the conversion of vanadium to a certain stage of oxidation. Aqueous sulphurous acid converts vanad-pentoxide in solution to tetroxide, which is perfectly unchangeable in acid liquors, so that these can be boiled for the repulsion of the excess of sulphur dioxide. The tetroxide solutions undergo a further reduction, which if not guarded against might make the test fallacious. I shall shortly be able to refer more fully to this process, but will mention here briefly that the tetroxide in solution, containing an excess of sulphuric acid, is converted into vanadium trioxide by carbonaceous matter (which is introduced by alcohol or with dust), and by sulphur at a temperature of  $120^{\circ}$ , and that at higher temperatures (about  $150^{\circ}$ ) the acid vanadic sulphate,  $V_2H_{24}SO_4 \cdot 2H_2O$ , separates in the form of insoluble needles, and at ca.  $200^{\circ}$  the yellow vanadic sulphate,  $V_2SO_4$ , appears as a heavy amorphous sediment mixed with the former. If such conditions are apprehended it is necessary to add permanganate until the test-solution remains pink after boiling, as proof that all vanadium is oxidised to the pentoxide; then to treat with sulphurous acid, and, after expelling the excess, titrate again with permanganate.

The colouration obtained by the permanganate generally disappears after a short time, and is reproduced by the first drop of this solution, to bleach again, and so on, until, after a large quantity (up to 20 per cent of what was used to produce the first pink) has been added, the solution becomes opaque by the separation of manganic peroxide. In every case the first appearance of the pink colour is the indication that all vanadium is converted into the pentoxide, and the quantity of permanganate used corresponds exactly with that required by an equivalent quantity of oxalic acid. In hot solutions the first appearance of pink is permanent. The reaction of the permanganate solution takes place instantaneously; the colour changes from blue, through green, to yellow and pink, indicating at every stage the quantity of the standard solution required. The titration of vanadium with a standard solution of permanganate is in fact one of the most elegant, expeditious, and accurate methods of volumetric analysis.

#### STANDARDISING PERMANGANATE SOLUTION WITH VANADIUM.

By Dr. B. W. GERLAND.

THE stability of the acid solutions of vanad-tetroxide and their beautiful reaction with permanganate, referred to in the preceding paper, recommend them as convenient for the valuation of this oxidising test-liquor. The following three vanadium compounds can easily be obtained

pure, and in fit condition for weighing:—Ammonium-vanadate,  $AmVO_3$ ; the insoluble vanadylous sulphate,  $V_2O_2 \cdot SO_4$ ; and the pentoxide,  $V_2O_5$ . The first dissolves readily; the sulphate becomes soluble in sulphuric acid, after treatment with soda; and the pentoxide is dissolved by digestion with hot, dilute, sulphuric acid. The solution is mixed with sulphuric acid, treated with sulphurous acid, boiled to expel the excess, and is then perfectly stable. The high price of vanadium compounds is scarcely an obstacle, as the same quantity can be used repeatedly. I have four solutions, containing vanadium equal to ca. 2.3 grms. to 0.23 gm. vanad-pentoxide, in spacious flasks, protected against dust, which have been oxidised with permanganate and reduced with sulphurous acid perhaps a hundred times during several years, without removal of the solutions from their vessels, and still give the reaction as accurately as when first prepared. The larger quantity corresponds with ca. 50 c.c. deminormal permanganate solution.

Macclesfield.

## PROCEEDINGS OF SOCIETIES.

### PHYSICAL SOCIETY.

December 15, 1877.

Professor G. C. FOSTER, F.R.S., President, in the Chair.

THE following candidates were elected Members of the Society:—W. E. Ayrton, J. M. Cameron, J. W. Clark, J. E. Judson, B.A., H. N. Mosely, M.A., F.R.S., Lord Rayleigh, M.A., F.R.S., W. N. Stocker, M.A., and H. T. Wood.

Mr. C. W. COOKE read for the author, Prof. S. P. THOMPSON, a paper on "*Permanent Plateau Films*," and exhibited the process of their formation. After a brief enumeration of the various attempts made by Plateau himself, Schwartz, Mach, Rottier, and others, most of which are described in the work of Plateau, the author described his own experiments on the subject. As the result of these, he concludes that the best results are obtained by using a mixture of 46 per cent of pure amber-coloured resin and 54 of Canada balsam, which should be heated to from  $93^{\circ}$  to  $95^{\circ}$  C. The frames for forming the films are made of brass wire, 0.3 m.m. in diameter, and when thicker wire is employed the films are found to be irregular, in consequence of the retention of heat by the metal. The films are obtained by simply introducing these frames into the heated mixture, and they harden almost immediately on exposure to the air; but better results are obtained by slow drying in an air-bath heated up to  $80^{\circ}$  C., and allowed to cool. In proof of the toughness of the films it was mentioned that a flat circular film 4 c.m. in diameter had supported a 50 gm. brass weight at its centre.

Mr. SEDLEY TAYLOR then exhibited some experiments in illustration of a paper on the colours exhibited by vibrating liquid films, which he has recently communicated to the Royal Society.

Dr. GUTHRIE exhibited a simple lecture illustration of the action of the telephone. Two similar coils of wire are placed, one on the end of a bar-magnet, and the other on a soft iron core. A tin disk, about 3 inches in diameter, is suspended by two threads almost in contact with one end of this latter, and when a similar disk is brought, at regular intervals, against the end of the magnet which is provided with the coil, a distinct movement of the first named disk is observed, which can be easily increased by properly timing the movement of the inducing disk.

PHILOSOPHICAL SOCIETY OF GLASGOW.

CHEMICAL SECTION.

November 26, 1877.

Professor JOHN FERGUSON, M.A., President, in the Chair,

A SHORT opening address was delivered by the President, in the course of which he announced his intention to prepare a more formal presidential address, to be submitted to the Section at a later period of the session. He also made some remarks on a movement which was being made by the Council with the view of raising a "Graham" medal and lecture fund, towards which the sum of fully £150 had already been obtained from a few subscribers.

Mr. JOHN MACTEAR then read a paper on "*The Regeneration of the Sulphur Employed in the Alkali Manufacture, as conducted at St. Rollox by the 'Mactear' Process.*" After referring to the Leblanc process, and to the fact that the two raw materials, sulphur and lime, are (with trifling exception) both completely lost as waste products, and form a most objectionable refuse material, the author spoke of the objection to the process as still existing, and said—Almost every chemist, even remotely connected with the alkali manufacture, has at one time or other of his career attacked the problem, although in most cases with but scant success. The attention of investigators seems primarily to have been turned in two directions:—

- 1st. Towards the production and subsequent utilisation of sulphuretted hydrogen from the alkali waste.
- 2nd. Towards the production of hyposulphites from the sulphur compounds of the waste—thus ultimately leading to the production of sulphur from mixtures of sulphides and hyposulphites by decomposition with hydrochloric acid.

Reference was also made to the labours of Gossage and many other chemists, and he said that of all the processes devised only four—those of Mond, Schaffner, Hoffman, and Mactear—have been worked on anything like a large scale with success; the first and last of these being by far the most successful. The process of Mr. Mond has been described very fully and clearly by the inventor in a paper read before the British Association in 1868, at Norwich, and also in papers read before the Glasgow Philosophical Society, and the Newcastle-on-Tyne Chemical Society. These may be referred to for details. Briefly stated, the process deals with the waste produced in the alkali manufacture, in promoting the partial oxidation of the sulphur and calcium compounds by forcing air through a mass of waste, then washing out the soluble compounds thus formed with water, and decomposing with hydrochloric acid. It was stated by Mr. Mond that the sulphur could be thus recovered at a cost of 20s. per ton. This statement was made before the process had been sufficiently worked on a large scale to enable the cost to be ascertained, and is much under the mark; indeed, when all the elements of cost have been added, it will be found that the cost of one ton of sulphur actually produced will be not much—if any—under 80s. per ton. The "Mactear" process owes its origin to the great nuisance produced by the natural oxidation of the enormous heaps of alkali waste, and its subsequent lixiviation either by rainfall or by springs under the heaps, and differs in the first instance from Mond's process, in that it proposes simply to deal with the drainage liquors from the deposits, and not by any special separate treatment of the waste.

The principle on which all these processes for the recovery of the sulphur have been based is identical, and lies in the decomposition of sulphuretted hydrogen by sulphurous acid, or such decompositions as are to all intents and purposes equal to this.

It is of course necessary that the lime sulphur compounds must be in such proportions that on the addition of hydrochloric acid with proper precaution, there shall

be practically no evolution of sulphuretted hydrogen; and in Mond's process it has been found extremely difficult to obtain in practice liquors of the required composition, and if the workmen are at all careless there is apt to be a considerable evolution of sulphuretted hydrogen.

In the "Mactear" process the apportionment of the various sulphur compounds is very simple, and the evolution of sulphuretted hydrogen, except in cases of the most gross carelessness, is very slight indeed. Although this process has until very recently only been in use at the works of Messrs. Charles Tennant and Co., at St. Rollox, yet by it more sulphur has been recovered than by any other process hitherto introduced.

The heaps of alkali waste at the St. Rollox Works have been accumulating for over forty years, and are chiefly deposited on the surface of an old "bog" or "peat moss," which has been formed in a natural basin in sandstone rock. This bog is of large extent, and contains many springs of water, which, rising up under the waste, dissolve out the soluble sulphur compounds, and give rise to a large flow of what is commonly called "yellow liquor," which is a complex sulphide of calcium, holding also in solution free sulphur. This liquor was for many years allowed to flow with the natural drainage of the land into a stream called the "Pinkston Burn," which, after traversing a considerable portion of the city of Glasgow as a covered sewer, falls into the river Kelvin at some little distance from its junction with the Clyde. This burn in its course receives liquid refuse of all sorts other than mere sewage, notably refuse from distilleries, and these being acid, gave off from the sulphide of calcium liquors sulphuretted hydrogen in such quantities as to give rise to a most intolerable nuisance, of which the public had good reason to complain.

After noticing some of the efforts which had been made from time to time to abate or remove the cause of complaint, and urging practical objections to Mond's process as fully tested at Messrs. Tennant and Co.'s Works, the author went on to say:—The very large amount of plant required also, and the fact that it was not found possible to work up by it all the drainage liquors, induced the writer to again carefully study the subject in all its bearings; and after a long series of experiments, many of them, like those of former workers in the same direction, failures, he succeeded in developing the process which has been so successfully worked at St. Rollox, and bears his name.

As has been said, the principle of all the processes for the recovery of sulphur from alkali waste lies in the mutual decomposition of sulphuretted hydrogen and sulphurous acid. The "Mactear" process depends on the decomposition of the sulphides of calcium by hydrochloric acid, in the presence of a source of sulphurous acid.

The process has various modifications, each of which is applicable under special circumstances:—

- 1st. The drainage liquor usually called "yellow liquor," is mixed with a small proportion of lime, and then treated with sulphurous acid, which it absorbs, giving a small quantity of sulphur. The liquid containing this sulphur in suspension is then decomposed at a temperature of about 140° F. This method gives good results, but is difficult to regulate, and is subject to the same objection as Mond's process, in that it is difficult to regulate the composition of the liquors, even when only a portion of the yellow liquor is treated with sulphurous acid, and then mixed with the remaining portion and hydrochloric acid. It is also, in consequence of this difficulty, apt to give rise to an evolution of sulphuretted hydrogen, and cause a nuisance.
- 2nd. The modification actually worked for the past five years, is that of using a solution of sulphurous acid in water. This is obtained either from pyrites, or from the refuse sulphur from the process.

Mr. Macfear described this modification at some length, as also the plant required in carrying it out, the cost of the same to produce from 30 to 35 tons of sulphur weekly, and the detailed cost of a ton of the recovered sulphur, namely 6rs., and said that the manufacture of sulphur by this process is a much more profitable means of using hydrochloric acid than is the manufacture of bleaching-powder, and he is of opinion that it will long continue so, because, in the first place, Sicilian sulphur cannot be reduced much below its present price without shutting up some of the mines, and reducing considerably the production there; and, secondly, the effect of the Alkali Acts and recent Royal Commission has been to increase the manufacture of bleaching-powder, and by an excess of production over demand, to keep the price at a point at which it is no longer remunerative to the manufacturer.

So far as the question of removal of nuisance is concerned, this process has been amply successful in dealing with the sulphide of calcium liquors which used to flow into the Clyde from the works at St. Rollox.

3rd. The third modification of this process is intended for use when the liquors are very weak in strength, say  $5^{\circ}$  to  $8^{\circ}$  T., in which case the cost of fuel becomes much enhanced.

It consists in obtaining a stronger solution of sulphurous acid by the production of a bisulphite of lime, or at least of a solution of sulphite of lime in sulphurous acid, which is used just as the sulphurous acid solution in the second modification is employed. As the old waste contains large quantities of sulphite of lime, it is utilised in this modification of the process by grinding it in water to a milk and treating this with sulphurous acid; thus obtaining a solution of sulphite of lime in sulphurous acid, and thus reducing considerably the amount of sulphur required to form sulphurous acid. More hydrochloric acid is of course required by this method, but it has great advantages to recommend it.

There can be no doubt, the author remarked, that the application of one or other of the modifications of the "Macfear" process to the waste drainage, from the heaps at the great centres of the alkali trade, such as Widnes and St. Helens, would reduce very greatly the nuisance complained of there. The St. Helens manufacturers have recently decided not to put any acid drainage into the celebrated Sankey Brook, and this will lead to its utilisation in one way or another. The most probable direction for it to take is that of the manufacture of bleaching-powder. Were, for instance, a combination of manufacturers along the course of the Sankey Brook to collect the drainage liquors, pump them to a convenient spot (in which the author's experience of nearly ten years shows there is little difficulty), and treat them with the acid of either one or various works, obtained by arrangement, he is confident the nuisance complained of in that district would be much reduced, and a handsome profit realised by the manufacturers.

## CORRESPONDENCE.

### CONTRIBUTIONS TO CHEMICAL ANALYSIS.

*To the Editor of the Chemical News.*

SIR,—M. Sergius Kern has replied to my letter *CHEMICAL NEWS*, vol. xxxvi., p. 32, criticising his contributions to your pages. Respecting the erroneous percentages of phosphorus and magnesium contained in magnesium pyrophosphate, I pointed out that it might be a typographical blunder, and M. Kern holds that the "error is evident." Unfortunately, however, the error was not evident to the gentleman who abstracted M. Kern's paper for the *Journal of the Chemical Society*.

Of M. Kern's statement respecting the composition of

$\text{Cr}_2\text{O}_3$  I need say nothing. We all of us make mistakes sometimes, and I should be very sorry to be held responsible for everything I had said and written.

M. Kern adheres to his statement that " $\text{H}_2\text{S}$  and  $\text{SO}_2$  are frequent not only in Russian coal-gas, which in St. Petersburg is made entirely from English coals." In England we sometimes meet with  $\text{H}_2\text{S}$  in the purified gas, but such cases are decidedly exceptional. As  $\text{H}_2\text{S}$  is always present in the crude gas, it is clear that it must co-exist there with the  $\text{SO}_2$  alleged to be frequently present in Russian coal-gas. The existence of  $\text{SO}_2$  in coal-gas is very curious, as it is not mentioned in any analyses of coal-gas which I can find recorded, and there are reasons for doubting the possibility of its presence. Chemists will be indebted to M. Kern if he will strengthen his statement by describing the tests by which he is in the habit of detecting  $\text{SO}_2$  in coal-gas.

With respect to M. Kern's discovery of davyum I have nothing to add to my former letter, in which I wrote "I am far from asserting that M. Kern's claim has not a sound basis." Certainly M. Kern's statements then required confirmation, and even now I think the density may be open to correction. But since that time M. Kern has described a number of characteristic properties of davyum, and I sincerely and cordially congratulate him on his discovery, and hope we may soon have the opportunity of inspecting specimens of the "little stranger" and its compounds. The fact that Bunsen had pointed out the probability of the existence of a new metal in the very residue in which M. Kern has found it, was not mentioned with the view of detracting from the discovery, though the analogy which M. Kern traces between the indication given by Bunsen of the place to look for a new metal, and the anticipation by Mendeleef of the probable properties of eka-aluminium, is not quite so apparent as might be wished.—I am, &c.,

ALFRED H. ALLEN.

Sheffield, December 10, 1877.

### THE INSTITUTE OF CHEMISTRY OF GREAT BRITAIN AND IRELAND.

*To the Editor of the Chemical News.*

SIR,—This Association, of which you gave some account in an article on "Professional Organisation of Chemists," published in the *CHEMICAL NEWS*, vol. xxxvi., p. 193, is now incorporated, and has begun active operations under Professor Frankland, D.C.L., F.R.S., &c., as President. Up to the present time more than 300 chemists have been elected as Fellows of the Institute by the Council.

In the article alluded to, the statement of qualifications required of candidates for admission to the Institute as Fellows or Associates, is correct, but with regard to the entrance fee to be paid by Fellows, it was resolved at an Extraordinary General Meeting, held for that purpose, that an entrance fee of two guineas shall be paid by every person who shall on or before February 2, 1878, be elected a Fellow of the Association, in addition to the annual subscription; but in the case of all persons elected after that date as such Fellows the entrance fee shall be five guineas, in addition to the annual subscription.—I am, &c.,

CHARLES E. GROVES, Secretary.

Somerset House Terrace, London, W.C.

**Determination of Tellurium.**—M. L. Kastner.—The tellurium precipitated by sugar is collected on a small filter and washed. It is then transformed into tellurous acid by moistening with a mixture of 2 vols. nitric acid, 1 vol. water, and 3 drops of sulphuric acid per 10 c.c. of mixture. The tellurous acid in acid solution is evaporated to dryness in a porcelain capsule and weighed.—*Zeit. für Anal. Chemie.*

# CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Moniteur Scientifique Quesneville.*  
December, 1877.

**Gout and Rheumatism Cured by Salicylate of Soda.**—Dr. Héry.—A medical paper of no chemical interest.

**New Researches on the Part Played by Alkalies in the Animal Economy.**—M. Mialhe.—A lengthy defence of the use of alkaline bicarbonates in diet and medicine. M. Guhler, in an appendix, calls to mind that alkaline cachexia is not altogether chimerical, and adds the caution that before strong doses of alkaline carbonates are prescribed the structural integrity of the kidneys ought to be ascertained.

**French Association for the Advancement of Science: Chemical Section:—**

1. **Insoluble Sulphur.**—Dr. Brame.—The author points out that the insoluble sulphur discovered by M. C. Deville is simply the vesicular sulphur described by him some years ago. As to the origin of this modification he does not agree with M. C. Deville. He obtains the insoluble sulphur by pouring sulphur, melted and kept at a high temperature, into a bath of bisulphide of carbon, either at the ordinary temperature or at the boiling-point, the maximum product being obtained in the latter case. The mixture should then be allowed to cool gradually, and not rapidly, as M. Deville maintains. He finally states that sulphur is met with in two essentially distinct forms, the one crystalloid, entirely soluble in bisulphide of carbon; and the other, colloid or utricular, insoluble in the same liquid. He considers that his utricular sulphur is identical in nature with the soft sulphur obtained by fusion.

2. **Researches on Piridin, Picolin, and their Derivatives.**—Prof. W. Ramsay, of Glasgow.—From an English source.

3. **Experiments on the Reaction of Anhydrous Bases and Acids.**—M. J. Béchamp.—Already noticed.

4. **Researches on Santonic Acid.**—Prof. Cannizaro.—An account of the action of hydriodic acid, chloride of acetyl, and chlorides of phosphorus upon santonic acid.

5. **Causes of the Production of Beet-root Treacle.**—M. Gunning.—The author mentions that there is no non-crystallisable sugar in treacle, but that all the sugar present is in the state of definite non-crystallisable compounds, from which the water cannot be eliminated.

6. **Separation of a Mixture of Lead, Zinc, and Silver.**—F. Maxwell Lyte.—The ore, ground and calcined, is treated with dilute hydrochloric acid in troughs of resinous wood, into which steam is blown to raise the temperature. The zinc, lead, and silver are thus converted into chlorides, the argentic and a part of the plumbic chloride remaining mixed with the gangue. The liquid is then run off, and allowed to cool, when nearly the whole of the plumbic chloride is deposited. The clear mother-liquid containing zinc chloride and excess of hydrochloric acid is syphoned back into the first tank, where it takes up a fresh quantity of chlorides of lead and silver, the gangue being thus exhausted after three successive decantations. To the entire solution now existing in the second tank scrap-zinc is added, when all the lead and silver is deposited as a metallic sponge. (It must be remembered that silver chloride is soluble in concentrated solutions of lead chloride.) From the residual liquor the zinc is precipitated as oxide by the addition of milk of lime.

7. **Preparation of Pilocarpin.**—M. Petit.—The leaves of jaborandi are exhausted with alcohol at 85°. The extract is distilled, and the aqueous residue first concentrated, and then diluted with distilled water to remove a resinous matter, and filtered. To the filtrate is added an excess of ammonia, and chloroform is then added thrice in succession to dissolve out the pilocarpine. On distilling off the chloroform impure pilocarpine remains behind, and is exactly neutralised with dilute nitric acid. The product, diluted with water and filtered, is evaporated to dryness in the water-bath. It is further purified by being dissolved in alcohol of 95 per cent, boiled, and filtered over animal charcoal. The yield is 5 grms. per kilo. The nitrate of pilocarpine has a rotatory power of +76° for the ray D. The base forms crystalline salts with the hydrochloric and hydrobromic acids.

8. **Process for Extracting Quinidin from the Quinoidin of Commerce.**—Dr. J. E. de Fry.—The hydrochloric solution of quinoidin is heated in the water-bath, and mixed with a solution of caustic soda (containing 40 grms. hydrate of soda per litre) to remove a black resinous matter. From the solution remaining the quinidin is separated, either by means of tartaric acid, or of potassium iodide. The author remarks that all the neutral salts of the cinchona alkaloids have an alkaline reaction.

9. **On Fermentation.**—M. Gunning.—The author's experiments yield no support to the supposed existence of anærobious beings, presumed capable of living without oxygen.

**Systems of Chemical Notation.**—A letter from M. Berthelot to M. Marignac.—The author, after pointing out that in France no official interference with chemical theories prevails at the universities, &c., maintains that the new school, to him, does not seem to have justified its pretensions. M. Marignac, in his reply, agrees with M. Berthelot that too great weight should not be laid upon questions whose solution will not change the laws and principal theories of chemistry.

**Determination of Manganese and Phosphorus in Spiegeleisen.**—M. C. Stöckman.—The author finds that iron and manganese cannot be completely separated by a single precipitation. Some manganese always remain along with the iron. It is therefore necessary, after having filtered and washed several times, to re-dissolve the ferric oxide, and to re-precipitate with acetate of soda. Even two precipitations do not suffice for absolute accuracy. As regards phosphorus, the differences in the results are due to the fact that some chemists dissolve the ore in nitric acid, and others in aqua regia, the quantity found being lower in the latter case. The author's procedure is as follows:—5 grms. of spiegeleisen, pulverised, are dissolved in 60 c.c. of pure nitric acid, of sp. gr. 1.2, in a glass beaker, capable of containing 800 to 1000 c.c., and which is covered with a watch-glass. The acid is added by degrees. When the mixture ceases effervescing the beaker is set on the sand-bath, so as to bring the contents to a boil. The substance is dissolved in ten minutes at the most, and the solution is then decanted into a porcelain crucible of 200 c.c. capacity, and evaporated to complete dryness on the sand-bath, covering with a watch-glass to prevent spitting. The crucible is then covered with a porcelain lid, and it is carefully heated over the lamp; the lid is then removed, and the heat is raised till all organic matter is burnt off, or at least decomposed. When completely cold, concentrated hydrochloric acid is added, and the crucible, covered with a watch-glass, is heated on the sand-bath till everything is dissolved. The liquid is then filtered into a beaker, and evaporated to approximate dryness, mixed with a little ammonia until the oxide of iron is thrown down, and then again with nitric acid till all is re-dissolved, boiling if needful. When quite cold, 50 to 60 c.c. of molybdenum mixture are added, and it is allowed to stand from twelve to twenty-four hours at a temperature of 30°

to 40°. The yellow precipitate is filtered off, and washed with Fresenius's mixture:—

Molybdenum mixture..	..	100 parts.
Nitric acid .. .. .	..	20 "
Water .. .. .	..	80 "

Then dissolved in dilute ammonia, and the solution slightly neutralised with hydrochloric acid; when cold, a solution of chloride of magnesium is added, and then ammonia till the liquid occupies a volume of 100 to 110 c.c. The phosphate of magnesia is calcined at a strong heat.

**Adulteration of Ground Madder, and of its Preparations.**—M. C. Benner.—The ordinary method of sophisticating madder is to substitute for part of the active colouring matter an inert powder, with which either the extract of a dye-wood or a powerful astringent has been incorporated. The spent bark from the tanneries, dried and powdered, and mixed as may be requisite with extract of chestnut, dry extract of pine-bark, Lima-wood or log-wood, or sometimes with various proportions of all these extracts, is the adulterant generally selected. The reagents for detecting this fraud consist of slips of white bibulous paper steeped in a solution of stannic chloride at 2° B., allowed to drain, and laid upon a plate of glass. Another reagent consists of the same kind of paper steeped in solution of copperas at the same strength, drained, and laid upon the glass by the side of the tin-paper. A portion of these papers is dusted over, whilst still moist, with the powder under examination. Upon a second portion of the papers is sprinkled a perfectly genuine sample, and upon a third portion a mixture which the operator has made up with the different extracts in known proportions. After the lapse of fifteen to twenty minutes the under side of the glass is exposed to a gentle heat till the paper is very dry; the adherent powder is then shaken off, and then we examine the spots of various shades which the extracts of dye-woods and of astringents have produced. Pure madder, madder-flower, and garancin produce no spots, but if the smallest quantity of dye-woods or of astringents has been added one or other of the papers will betray the fraud by spots more or less numerous. The green tannin of certain resinous woods, and especially of pine-bark, is not easily detected by this method. The following method may therefore be used:—5 grms. of the madder, &c., in question are weighed out, mixed with 65 grms. of distilled water at 50°, and 35 grms. of commercial alcohol are then added. The infusion is stirred, and let stand for fifteen minutes, then filtered into a porcelain capsule. Strips of filter-paper are steeped in this liquid as uniformly as possible, dried in the air, and when perfectly dry submitted to the following reagents. A paper should always be prepared for comparison with a perfectly pure specimen. The reagents are:—(1.) Acetate of copper obtained by the double decomposition of—

Sulphate of copper ..	..	10 parts.
Sugar of lead .. ..	..	10 "
Distilled water .. ..	..	100 "

(2.) Acid chloride of tin, prepared with—

Stannous chloride ..	..	20 parts.
Hydrochloric acid ..	..	5 "
Distilled water .. ..	..	100 "

(3.) Nitrate of silver, at 10 per cent of the salt.

(4.) Copperas, at 10 per cent.

(5.) Carbonate of soda, at 10 per cent.

A piece of white calico is rolled up so as to form a kind of brush, dipped in each of the test-liquids, and with it one or two transverse strokes are made upon the paper saturated with the alcoholic extract. The paper is then allowed to dry for three-quarters of an hour without exposure to the sun. The coloured reactions upon the papers are then compared with those of the standard sample. The better to detect pine-bark, the infusion of the suspected madder may be previously allowed to ferment. 100 grms. of the sample are infused in 375 grms. of water at 40° C. : grms. of beer-yeast are then added,

and the mixture is allowed to stand over-night at 40°. In the morning 500 grms. of water at 50° and 200 grms. of alcohol are added, allowed to stand for half an hour, filtered, and in the filtrate slips of paper are steeped, and examined as above. Or slips of filter-paper may be suspended so as to dip into the alcoholic liquid, and left hanging over night. The liquid ascends by capillary attraction, and the colouring matters becoming oxidised give the paper a different shade, according to the nature of the foreign bodies which have been added to the madder.

**Experiments on the Formation of Artificial Ultramarine.**—M. J. Plicque.—Already noticed.

— — —  
*Bulletin de la Societe Chimique de Paris,*  
No. 11, December 5, 1877.

**New Researches on Chemical Phenomena produced by Electricity of Tension.**—M. Berthelot.—Ozone is formed equally under the influence of both electricities, the oxygen in each tube only being in contact with the internal armature. The proportions are very variable, but, as a rule, the positive electricity produces in the majority of cases the more ozone. In none of the experiments made with the Holtz machine has the author observed the smallest trace of nitrogen compounds produced from mixtures of oxygen and nitrogen, whether moist or dry. With the effluve of Ruhmkorff's apparatus traces have been observed, but only at the highest tensions. Acetylen, on the other hand, is produced in notable quantity in the vapours of organic compounds inclosed along with nitrogen in tubes containing a metallic armature, influenced by the discharges of the Holtz machine. The absorption of nitrogen by organic compounds is effected equally by both electricities, and at the weakest as well as at the strongest tensions, though the time required in the former case is longer. Along with the nitrogenous compounds there is formed not a trace of ammonia, nitric or nitrous acid, or hydrocyanic acid.

**Fixation of Nitrogen upon Organic Bodies, and Formation of Ozone under the Influence of Feeble Electric Tensions.**—M. Berthelot.—The author's experiments have been performed with a battery without closing the circuit, and in conditions which may be reduced to a constant difference of potential between the two armatures. The results obtained have been the formation of ozone and the fixation of nitrogen in organic bodies, such as paper and dextrin.

**Certain Observations upon the Mechanism of Chemical Reactions.**—M. Berthelot.—Already noticed.

**Hydrogenation of Benzol and of the Aromatic Compounds.**—M. Berthelot.—The author's method for saturating organic compounds with hydrogen is well known to be founded on the use, in large excess, of an aqueous solution of hydriodic acid, saturated in the cold and applied for a considerable time at a heat of 275° to 280°. By this means he succeeds in reducing benzol, &c., to the composition of absolutely saturated carbides, such as hexylen hydride, C<sub>12</sub>H<sub>14</sub>, volatile about 69°, a compound which he has formerly pointed out as the ultimate term of hydrogenation of benzol, and the identical term of saturation, moreover, both for the fatty and for the aromatic series.

**Observations on the Principle of Maximum Work, and on the Spontaneous Decomposition of Hydrated Binoxide of Barium.**—M. Berthelot.—Already noticed.

**Swedish Correspondence.**—P. T. Cleve.—This correspondence comprises accounts of the researches of M. O. Widmann on the chlorated derivatives of naphthalin; a paper by the same author in conjunction with M. Atterberg, on the derivatives of dichlorated  $\gamma$ -naphthalin; and a memoir on the bromated derivatives of naphthalin, by M. S. Jolin.

**Experiments relating to the Formation of Artificial Ultramarine.**—J. F. Plicque.—Already noticed.

**New Method of Extracting Scammony Resin.**—Emile Perret.—The author exhausts the crude pulverised scammony with boiling alcohol, and neutralises the dark alkaline liquid with a few drops of sulphuric acid. The colouring-matters are precipitated as a lake, and the clear supernatant liquid is filtered off; the alcohol is distilled off, and the residual pure resin is dried on the sand-bath, raising the temperature gradually to 104°.

**Preparation of Pure Hydrogen.**—E. Varenne and E. Hebré.—The authors pass the gas through the following solution:—

Bichromate of potassa	..	..	100 grms.
Water	..	..	1000 „
Concentrated sulphuric acid	..	..	50 „

In this manner all traces of sulphur, arsenic, antimony, carbon, &c., are withdrawn.

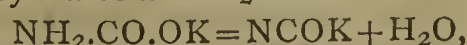
**On Tanning-Woods, and in particular that of Quebracho aspidosperma, and its Application in Dyeing.**—M. J. Arnaudon.—In general it may be said that plants whose wood endures in wet soils, experiencing only a slow alteration, contain, in the wood itself, tannin, whether associated with resinous matters or otherwise. Among such woods may be noticed the Quebracho, a tree belonging to the family of the Apocineæ, specimens of which were displayed by various South-American States at the Vienna Exhibition. In Paraguay the wood of the tree has long been in use for dyeing brown shades, though the employment of the wood as a tanning and dyeing agent is of more recent date. It contains a colourable compound, which, under the influence of light and air, is transformed into an orange-yellow dye, and it is also possible to obtain from the same wood a very beautiful yellow colouring compound.

*Journal für Praktische Chemie.*  
Nos. 14 and 15, 1877.

**Action of Ethylic Chloro-carbonate on Sodid Cyanide.**—P. Bässler.—This reaction yields ethylic cyamido-carbonate,  $\text{NH}(\text{CN})(\text{COOC}_2\text{H}_5)$ , and ethylic cyamido-dicarbonate,  $\text{N}(\text{CN})(\text{COOC}_2\text{H}_5)_2$ . The former is a yellowish syrupy liquid, with a strong acid reaction, forming crystalline salts with metals, which is odd in view of its character as a substituted ammonia. It is not very stable, and is decomposed by water into cyanamide,  $\text{C}_2\text{H}_5\text{OH}$  and  $\text{CO}_2$ . The sodium salt forms, with ethylic chloro-carbonate, the dicarbonate, which possesses remarkable crystalline properties, and melts at 32°. A large number of reactions of both ethers are described. Neither of them can be saponified.

**Precipitation of Lime with Alkaline Carbonates.**—E. Drechsel.—By means of an exceedingly complicated but ingenious apparatus, which is described at length, the author ascertains, in opposition to Hofmeister's statements, that  $\text{CaCO}_3$  is almost perfectly insoluble in alkaline liquids; that no trace of it is to be noticed on boiling these solutions: and that when  $\text{CaCO}_3$  does appear in an ammoniacal solution on heating, with complete exclusion of  $\text{CO}_2$  from the surrounding air, it is a reaction for carbamic acid.

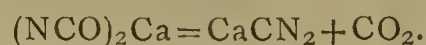
**Some New Carbamates.**—E. Drechsel.—The only known compounds of carbamic acid hitherto were the ethers and the ammonium salt. The author has succeeded in preparing salts with K, Na, Ca, and Sr, which show no small degree of stability. They are formed, in general, by passing  $\text{CO}_2$  through the solutions of the various bases in a strong ammoniacal solution, and precipitation by the addition of alcohol. The K salt is also formed by passing  $\text{CO}_2$  through a solution of potassic ethylate which has been saturated with  $\text{NH}_3$ . They are all decomposed by heating into cyanates and  $\text{H}_2\text{O}$ :—



the salts of the alkaline earths being decomposed, further,

into  $\text{CO}_2$  and cyanides, and when dissolved in water gradually change into carbonates.

**Two New Methods of Preparing Cyanamide.**—E. Drechsel.—The first is by adding sodium amide to fused potassium cyanate,  $\text{NCONa} + \text{NaNH}_2 = \text{Na}_2\text{CN}_2 + \text{H}_2\text{O}$ , which yields disodium cyanide, and explains why  $\text{CO}_2$  and  $\text{NH}_2\text{Na}$  do not yield sodium carbamate, the latter being always decomposed by the  $\text{NH}_2\text{Na}$ . The second method consists in heating the cyanates of the alkaline earths, and treatment with  $\text{HCl}$ —



These doubly substituted cyamides,  $\text{KNaCN}_2$ ,  $\text{BaCN}_2$ ,  $\text{CaCN}_2$ , &c., show a remarkable stability when exposed to heat, but are decomposed by  $\text{H}_2\text{O}$  under formation of the mono compounds.

**Action of Ferricyanides on Metallic Silver.**—J. E. Eder.—The author has recommended lately the use of a solution of red prussiate and lead nitrate for intensifying silver negatives, and explained the reaction by the equation  $2\text{Pb}_3\text{Fe}_2\text{Cy}_{12} + 4\text{Ag} = 3\text{Pb}_2\text{FeCy}_6 + \text{Ag}_4\text{FeCy}_6$ . In reply to an attack of Wartha's on this, he shows that the reaction product of ferricyanide of lead on silver consists exclusively of ferrocyanides of lead and silver in the proportions 3:1.

**The Three Isomeric Oxy-benzoic Acids.**—H. J. Smith.—By the action of  $\text{NH}_3$  at a high temperature salicylic and paroxy-benzoic acids are decomposed into  $\text{C}_6\text{H}_5\text{OH}$  and  $\text{CO}_2$ , while metoxy-benzoic acid forms the nitrile,  $\text{C}_6\text{H}_9\text{OH.CN}$ . The same results accompany the distillation with  $\text{CNSK}$ , and coincide with the general experience that the ortho and para acids show a great similarity in their chemical deportment, and differ widely from the more stable meta acid. The nitrile of the latter crystallises in colourless laminae, melts at 82°, and yields a mono-nitro-compound, from which  $\text{C}_6\text{H}_3\text{OH.NO}_2\text{COOH}$  is derived by boiling with alkalies.

*Reimann's Färber Zeitung,*  
No. 44, 1877.

This issue contains a notice of Dr. Seidler's experiments in proof of the innocence of magenta when taken internally in daily doses of from 0.05 to 0.1 gm.

According to Dépiene, a decoction of the bark of *Syzigium Jambolanum*, applied as a topping to vat-blues, increases their permanence. This bark contains 11 per cent of tannic acid, and is capable of being used as a substitute for sumach.

## NOTES AND QUERIES.

**Davy's Test for Arsenic.**—Please let me know through your paper what Davy's test for arsenic is, referred to by Mr. Merrick in your last issue.—ARSENICUM.

**Cement.**—Will any of your readers inform me of an acid and heat proof cement for repairing broken chemical apparatus or filling up cracks.—O. Q.

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2 " " Sulphuric Acid,	
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# THE CHEMICAL NEWS.

VOL. XXXVI. No. 944.

## NOTE ON THE ACTION OF LIGHT UPON SOLUTION OF OXALIC ACID.

By ARTHUR DOWNES, M.D., and  
THOMAS P. BLUNT, M.A. Oxon, F.C.S.

IN the course of an investigation into the physiological action of light upon minute organisms, the results of which are embodied in a paper read before the Royal Society on the 6th inst., we observed that oxalic acid in a solution of decinormal strength is entirely destroyed when freely exposed to sunlight for some time; a similar solution under parallel conditions, with one exception—that the tube containing it was encased in an opaque material—remaining to all appearance entirely unchanged.

The destruction of the oxalic acid in the insulated tube was so complete at the end of two months, when the solution was examined, that it had no action on litmus-paper, and gave no precipitate with calcium chloride; the reaction with potassium permanganate was so slight as to be scarcely appreciable. The nature of the change—whether it be the result of oxidation or of pure disintegration of the molecule—will form the subject of a future enquiry, but we think the fact itself is of sufficient interest for chemists to justify the present communication. One obvious inference of a practical character is that analysts who still use oxalic acid as a standard should protect the solution from light.

Shrewsbury, December 8, 1877.

## DETERMINATION OF INDIGO IN THE PRESENCE OF PER. AND PROTO-SALTS OF IRON.

By HUGH M. WILSON.

As the most reliable method for estimating indigo depends upon its oxidation into isatin, &c., by means of an oxidising body, such as permanganate or bichromate of potash, a difficulty naturally presents itself when per- and proto-salts of iron are present.

Having had occasion to analyse a mixture of this description it occurred to me that owing to the precipitation of indigo by the addition of a soluble salt of barium to sulphindigotic acid a complete separation of the iron salts in their normal condition might thus be established.

0.05 gram. of proto-sulphate of iron was accordingly dissolved in water and mixed with 50 c.c. of per-nitrate of iron (which contained 0.135 gram. of peroxide) and to this was added 0.01 gram. of indigotin dissolved in sulphuric acid. Chloride of barium was now added to the mixture, and the precipitate, consisting of indigo and sulphate of barium, filtered off and washed. The filtrate was then titrated with standard permanganate of potash solution, of which it required 18 c.c., being the same amount as previous 0.05 gram. of proto-sulphate of iron had taken for complete oxidation. Ammonia was added to the solution, now containing the whole of the iron as a per-salt, and precipitated peroxide of iron, washed, dried, and ignited.

The weight of the sesquioxide of iron was 0.150 gram., and on deducting 0.015, viz., the amount which existed as proto-salt, the remainder gave the amount of per-salt

taken, viz., 0.135 gram. A solution containing the same proportionate amounts of iron and indigo was now titrated with the same permanganate of potash solution previously used for the iron estimation (strength 100 c.c. = 0.165 gram. indigo), 24 c.c. were required to decolourise the indigo, and on deducting 18 c.c. (the amount required by the iron) the remaining 6.6 expressed the value of the indigo, viz., 99 per cent. Thus there was—

	Taken Fe <sub>2</sub> O <sub>3</sub> .	Found Fe <sub>2</sub> O <sub>3</sub> .
0.05 proto-sulphate of iron ..	0.0143	0.015
50 c.c. per-nitrate of iron ..	0.1350	0.135
	0.1493	0.150
	Indigo. 0.0100	Indigo. 0.0099

Heaton Mersey, December 4, 1877.

## COMPOSITION OF GAS FROM LIME-KILNS

By G. CARR ROBINSON and J. STUART THOMSON.

SOME time ago a statement appeared in the *CHEMICAL NEWS*, vol. xxxv., p. 208, to the effect that the gases liberated from lime-kilns consisted almost entirely of carbonic oxide (CO), to the exclusion of carbonic acid (CO<sub>2</sub>). As this appeared to us to be contrary to generally accepted opinion, and having lately had facilities offered, we were induced to examine the gases evolved from some kilns in this neighbourhood.

The limestone burnt consists of the varieties known as "blue" and "white." The seam, which is a thick one, runs below a bed of shale, and contains a considerable quantity of organic matter, chiefly of a bituminous character. The subjoined analyses of the two varieties cause them to be classified as what is technically known as "fat."

	"Blue."	"White."
Carbonic acid (CO <sub>2</sub> ) ..	41.618	43.911
* Lime .. .. .	51.681	54.077
Magnesia .. .. .	1.078	traces
Ferrous oxide .. ..	0.652	0.656
Alkalies .. .. .	0.415	traces
Organic matter .. ..	1.874	1.243
Silica .. .. .	2.745	0.482
	100.063	100.369
* Equal to carbonate of lime ..	92.287	96.566

The samples of gas examined were, in both cases, taken from the top of the charge; that marked I. was drawn at 11.30 a.m., one and a half hours after charging, the kiln being then in full operation; that marked II. was drawn at 3.30 p.m., while charging was going on; these periods being selected with a view of giving an idea of the composition of the gases throughout the whole period of reduction.

We would only further remark that carbonic acid (CO<sub>2</sub>), carbonic oxide (CO), and oxygen were alone determined, the difference being stated as residue, which may be assumed to consist of nitrogen mixed with small quantities of hydrocarbons.

	Volumes at 0° C. and 760 m.m.	
	I.	II.
Carbonic acid (CO <sub>2</sub> ) ..	27.04	7.05
Carbonic oxide (CO) ..	8.09	5.76
Oxygen .. .. .	0.17	4.40
Residue .. .. .	64.70	82.79
	100.00	100.00

University of Edinburgh.

# REPLIES TO INQUIRIES BY THE GERMAN GOVERNMENT AS TO THE WORKING OF THE SALE OF FOOD AND DRUGS ACT.

THE following are questions submitted to the Society of Public Analysts by Dr. Rottenburgh, the Representative of the German Government, and the answers as agreed to at a Special General Meeting of the Society on the 7th inst:—

1. Is the definition of offences in the Sale of Food and Drugs Act a satisfactory one?

Certainly not; the definition of our Society should be adopted. See *Proceedings of the Society of Public Analysts*, page 2\* (a copy of which has been sent to Dr. Rottenburgh).

2. Is it desirable to define adulteration in relation to a fixed standard of composition for each article of food, or should the definition be a general one?

The definition should be general except as regards the articles mentioned in the "Limits" (see *Proceedings* referred to above, page 2\*). Power should be given to the Home Secretary, or some other similar officer as the Central Authority acting on the advice of the Body of Referees, to make such additions to those limits as from time to time might be desirable.

3. Would it be advisable to have several authorities, with power to fix the standards, or would it be better to have only one Central Authority with that power?

The definition of standards and limits should be embodied in a Schedule to the Act passed by the Imperial Parliament, subject to revision, as before mentioned, by the Home Secretary or some other similar officer, on the advice of the Body of Referees.

4. Suppose an Analyst fixed a certain minimum of standard,—e.g., in the case of milk,—would not all dealers in milk dilute it down to that standard?

Most probably, but no Analyst should have power to fix such a standard without the consent of the Body of Referees.

5. Has the punishment of imprisonment often been employed, or has the fine been sufficient?

As far as we are aware imprisonment has only been inflicted in a few cases; fines, if heavy enough,

have generally been sufficient, but in many cases the fines are not heavy enough.

6. Would it be advisable to publish the punishments inflicted?

Yes, at the discretion of the Court.

7. Would it be advisable, besides either money-fine or imprisonment, to authorise the confiscation of the stock which has been found to be adulterated?

Yes, when possible after conviction, at the discretion of the Court.

8. Ought the retail dealer to be compelled to give the name of the wholesale dealer of whom he purchased the adulterated article?

Yes.

9. In a case of adulteration found to be *injurious to health*, would it be advisable to provisionally seize the article as soon as the Analyst has given his certificate?

Yes, decidedly.

10. Would it be advisable to state on the label of a mixed article the percentage of that mixture?

Yes, the label should state the maximum percentage of foreign ingredients contained in the mixture.

11. Would it be advisable to make the appointment of an Analyst in every district compulsory?

Certainly.

12. Is it advisable to leave the appointment of an Analyst to the local authority?

Yes, subject to confirmation by the Central Authority.

13. Have the selected Analysts often been rejected by the Local Government Board?

Very rarely.

14. In what manner should Analysts be paid?

By yearly salary for a fixed number of samples; an increased payment to be made if more than that number of samples are analysed, at a fixed fee for each such additional sample.

15. Is it advisable to have Analysts' Districts large or small?

Large.

16. Has it often happened that several local authorities have the same Analyst, and, where it is so, has it proved successful?

It has frequently occurred, and is certainly desirable.

17. Does it often occur that a private person prosecutes in adulteration cases?

Very rarely.

18. Have the provisions of Section 14 of the Act proved sufficient?

They are open to objection, but have answered moderately well.

19. Have the Analysts' reports been collected?

Yes, collected and collated by the Local Government Board, and the numerical results published in abstract.

20. Is it advisable for the Analyst to appear in Court, and does that often occur?

It is advisable that there should be power for either party to call him if required, on payment to him of a suitable fee. It occurs occasionally here.

21. Have the Inland Revenue Chemists often been appealed to?

In a very few instances.

22. Have they often differed from the Public Analysts?

In about half the number of the very few cases referred to them.

23. Would it be desirable to have a different Court of Appeal?

Yes, decidedly. A Body of Referees should be nominated by the Central Authority, and should consist of Analysts of special experience, to each of whom should be deputed the reference in all disputed cases as to a particular article of food, drink, or drugs, —i.e., each referee should have made a special study

\* Extracts from *Proceedings of the Society of Public Analysts* vol. i., p. 2:—

*Definition of an Adulterated Article.*—An article shall be deemed to be adulterated—

(a.) In the case of food or drink.

1. If it contain any ingredient which may render such article injurious to the health of a consumer.
2. If it contain any substance that sensibly increases its weight, bulk, or strength, or gives it a fictitious value, unless the amount of such substance present be due to circumstances necessarily appertaining to its collection or manufacture, or be necessary for its preservation, or unless the presence thereof be acknowledged at the time of sale.
3. If any important constituent has been wholly or in part abstracted or omitted, unless acknowledgment of such abstraction or omission be made at the time of sale.
4. If it be an imitation of, or be sold under, the name of another article.

(b.) In the case of drugs.

1. If when retailed for medicinal purposes, under a name recognised in the *British Pharmacopœia*, it be not equal in strength and purity to the standard laid down in that work.
2. If when sold under a name not recognised in the *British Pharmacopœia* it differ materially from the standard laid down in approved works on "Materia Medica," or the professed standard under which it is sold.

*Limits.*—The following shall be deemed limits for the respective articles referred to:—

Milk shall contain not less than 9 per cent by weight of milk solids not fat, and not less than 2.5 per cent of butter fat.

Skim milk shall contain not less than 9 per cent by weight of milk solids not fat.

Butter shall contain not less than 80.0 per cent of butter fat.

Tea shall not contain more than 8 per cent of mineral matters, calculated on the tea dried at 100° C., of which at least 3 per cent shall be soluble in water, and the tea as sold shall yield at least 30 per cent of extract.

Cocoa shall contain at least 20 per cent of cocoa fat.

Vinegar shall contain not less than 3 per cent of acetic acid

of some one or more articles, and all disputed cases in reference to those articles should be submitted to him, and he should be liable, on the application of either party, to be called upon to appear in Court.

24. Has Section 25 of the Act proved successful?

No. Quite abortive.

25. Would it be advisable that the Analyst should state in his certificate simply that the article is "pure" or "adulterated," or would it be better to state the nature of that adulteration exactly?

It would be better to state as exactly as possible the nature and proportion of the foreign admixture.

26. Would it be advisable to empower the police, with the sanction of the magistrate, to visit suspected beer-shops, tea stores, factories, &c., to search?

It is desirable that the police or other officers should have power to enter places wherein it is suspected that articles of food which are unfit for the food of man are kept.

27. What qualifications should an Analyst possess?

Analysts should be thoroughly educated chemists, of practical experience, possessed of sufficient skill in the use of the microscope, and of some general knowledge of the more common kinds of poisons and substances injurious to health. The chief point, however, is that their education as chemists, &c., should enable them out of their own resources to meet difficulties as they arise, and to recognise clearly all cases in which their own general or chemical knowledge or the authorities available are not sufficient to enable a decided opinion to be pronounced on a sample.

## LIQUEFACTION OF OXYGEN.

STUDENTS of chemistry will be interested by the following telegram from Prof. Pictet, of Geneva, which was received on the 24th inst. by Prof. Tyndall, and which appeared in *The Times* on Christmas day:—"Oxygène liquifié Samedi par acides sulfureux et carboniques combinés. Pression 320 atmosphères. Température 100 deg. Centigrade de froid." Hitherto all attempts to liquefy oxygen have failed.

On the 26th inst. the following paragraph appeared in *The Times*:—"Messrs. Raoul Pictet, of 20, Rue de Grammont, Paris, send us the following extract from the *Journal de Genève*, dated December 23, which bears on the subject referred to in a telegram with which we were favoured yesterday by Prof. Tyndall:—"Une des expériences de physique les plus intéressantes de notre temps vient d'être exécutée à Genève avec un rare bonheur dans les ateliers de la Société pour la Fabrication des Instruments de Physique. Notre concitoyen, M. Raoul Pictet, à réussi à obtenir à l'aide d'appareils ingénieusement combinés la liquéfaction du gaz oxygène, un des éléments constitutifs de l'air atmosphérique. Voici en deux mots les principes à l'aide desquels on a obtenu ce curieux résultat. Par une double circulation d'acide sulfureux et d'acide carbonique, ce dernier gaz est liquéfié à une température de 65 degrés de froid sous une pression de 4 à 6 atmosphères. L'acide carbonique liquéfié est conduit dans un tube long de 4 mètres; deux pompes à action combinée produisent un vide barométrique sur cet acide qui se solidifie par suite de la différence de pression. Dans l'intérieur de ce premier tube, contenant, ainsi qu'il vient d'être dit, de l'acide carbonique solidifié, passe un tube d'un plus petit diamètre, ou circule un courant d'oxygène, produit dans un générateur contenant du chlorate de potasse, et dont la forme est celle d'un volumineux obus, aux parois assez épaisses pour prévenir tout danger d'explosion. La pression peut aller ainsi jusqu'à 800 atmosphères. Hier matin, tous les appareils étant disposés comme nous venons de l'indiquer, et sous une

pression qui n'a pas dépassé 300 atmosphères, un jet liquide d'oxygène a jailli de l'extrémité du tube, au moment où le gaz comprimé et refroidi passait de cette haute pression à la pression atmosphérique. Ce qui fait le grand intérêt scientifique de cette expérience, c'est qu'elle démontre expérimentalement la vérité de la théorie mécanique de la chaleur, en établissant que tous les gaz sont des vapeurs pouvant passer par les trois états—solide, liquide, et gazeux. Il y a une quinzaine de jours, M. Cailletet avait réussi à liquéfier le bioxyde d'azote, sous une pression de 146 atmosphères et à une température de 11 degrés de froid. Après l'expérience de M. Raoul Pictet, il ne reste plus que deux gaz qui aient encore échappé à l'épreuve de la liquéfaction, l'hydrogène et l'azote. La belle expérience que nous venons de résumer sera, nous dit-on, répétée Lundi et les jours suivants, avec quelques légers changements dans les procédés et dans les dispositions des appareils."

## PROCEEDINGS OF SOCIETIES.

### MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

Ordinary Meeting, November 27, 1877.

Dr. R. ANGUS SMITH, F.R.S., Vice-President, in the Chair.

MR. G. S. WOOLLEY presented to the Society a photographic portrait of Dr. Dalton, enlarged from a Daguerreotype taken by the late Mr. John Parry about the year 1841; and also a photograph of the first prospectus of Dalton's School.

On the motion of Mr. BAILEY, seconded by the Rev. W. GASKELL, the thanks of the Society were unanimously voted to Mr. Woolley for his valuable donations.

"On the Origin of some Ores of Copper," (Part I.), by CHARLES A. BURGHARDT, Ph.D., The Owens College. To endeavour to trace the various ores of copper to one fundamental source, and to study the relationships probably existing between the copper compound and its accompanying minerals, has appeared to me a subject of great interest, in fact one which has engaged my attention for some time. The commonest occurring ore of copper is undoubtedly cuprite ( $\text{Cu}_2\text{O}$ ), either independently or more often associated with malachite, azurite, brown iron ore, and native copper. Scarcely a specimen of copper ore can be obtained (with the exception of the sulphides) which does not exhibit more or less cuprite in intimate intermixture with the other ore; whence it must be inferred that all, or almost all, the ores of copper have been formed by aqueous and not by plutonic action, as cuprous oxide is undoubtedly prepared with greater facility by the wet method (that is, from cuprous or cupric solutions) at a comparatively low temperature than by the dry method at a very high temperature. I will briefly state in which way cuprite (that is, the crystallised cuprous oxide) has been obtained by different authors, first by the dry method and secondly by the wet method.

#### Preparation of Cuprite.

*Dry Methods of Preparation of Cuprite.*—1. A mixture of 24 parts of cupric sulphate and 29 parts of copper turnings heated to redness in a well-closed crucible furnishes eventually a reddish brown crystalline mass, which is cuprite.

2. A mixture of 100 parts of cupric sulphate and 57 parts of soda crystals is heated until all the water of crystallisation is driven out, the residue powdered finely, and 37 parts of copper turnings are added, and the whole mixture heated in a crucible to a white heat for half an hour. On washing out the cooled mass with water

cuprite of a very fine colour is obtained. (Wöhler and Liebig, *Pogg. Ann.*, xxi., 581.)

3. Crystals of this substance are often obtained in the slags obtained in the smelting of copper ores.

It will readily be observed from the above that an intense heat is requisite for the formation of cuprite by the dry method.

*Wet Methods of Preparation of Cuprite.*—1. A solution of equal parts of cupric sulphate and grape sugar is mixed with sufficient caustic soda solution to dissolve all the resulting precipitate and then gently heated; cuprous oxide then separates out in the form of a crystalline powder. (Mitscherlich, *Journ. Prakt. Chem.*, xix., 430.)

2. Bequerel (*Comptes Rendus*, xlv., 308) describes a beautiful method which is applicable for the preparation of many minerals. He filled a test-tube with a neutral solution of cupric nitrate, placing a little cupric oxide and a clean strip of copper plate at the bottom, closed the tube air-tight and left it to itself for many months. In this way he succeeded in obtaining small shining cubes of cuprite.

3. A. Kopp (*Fahrb. f. Min.*, 1861, 508) states that if a mixture of solutions of cupric sulphate and ferrous sulphate be treated by an alkaline carbonate, carbonic acid gas is evolved and a mixture of ferric hydrate and hydrated cuprous oxide is precipitated, the latter becoming crystalline after the expiration of some time.

Of the three methods given above that of Kopp undoubtedly furnishes one of the most probable processes by which many large deposits of the so-called tile ore and copper pitchblende have arisen; but there are again many other deposits of cuprite which may easily have been formed in other ways. I will not discuss at the present time the various opinions upon the formation of copper ores expressed by some very eminent and competent authorities, but I may mention that Dr. Ferdinand Wiebel, in a lengthy and exhaustive treatise (*Das Gediegen Kupfer und Roth Kupfererz*, Hamburg, 1864) concludes that the native metal and cuprite have in *all* cases been formed from a cupric sulphate solution (obtained by the oxidation of copper pyrites) through its reduction by a solution of ferrous sulphate (also derived from the oxidation of copper pyrites). This statement is doubtless correct in the case of some formations, but there are many others where it is questionable. Gustav Bischoff points out in his "Chemical and Physical Geology" that "It is certain that the contents of a lode are of later date than the adjoining rock, so that it can be shown that these contents originate from the adjoining rock, and if it can be ascertained what compounds of the metal exist in that rock, the previously existing minerals may be distinguished from those of later date; but the determination of this point is attended with great difficulties and is generally impossible." It is a well-ascertained fact that all the ores of copper are found mostly in crystalline rocks or metamorphic rocks derived from them (some ores, however, being found in newer formations); and Struve (*Ueber die Nachbildung der Natürlichen Heilquellen*, Heft 2, 17) has proved in the most conclusive manner that granite, porphyry, phonolite, gneiss, basalt, clay slate, trachyte, &c., contained a more or less appreciable amount of sodium chloride, and it is also well known that nearly every spring water flowing from rocks contains sodium chloride or a chloride of one of the alkaline earths (magnesium chloride). Further, it has been shown by Delesse (*Fahrb. f. Min.*, 1862, 605) that all rocks are *saturated* with water, and it is also a well-ascertained fact that iron pyrites ( $\text{FeS}_2$ ) is disseminated throughout *all* crystalline rocks. Having these facts before me, I made an experiment in order to ascertain what reactions would occur on heating iron pyrites and a solution of cupric chloride together in a sealed tube at a moderately high temperature. Small pieces of pure iron pyrites were placed in a glass tube, then covered with a moderately strong solution of pure cupric chloride, and the tube sealed up and heated for fourteen days at a temperature varying from  $135^\circ$  to

$210^\circ \text{C.}$ , but the greater part of the time the temperature oscillated between  $150^\circ$  and  $170^\circ$ . On the seventh day the colour of the cupric chloride had become considerably lighter, and a small deposit of violet-red crystalline cuprite was observed adhering to the sides of the glass tube, whilst on allowing the tube to cool it was observed that a very considerable amount of cuprous chloride had crystallised out in beautiful transparent colourless tetrahedrons. On the fourteenth day the tube was opened, as no further changes had taken place, and the contents examined and found to consist principally of cuprous chloride, with a small quantity of unaltered cupric chloride; there being at the same time a good amount of ferric sulphate and cupric sulphate present. The deposit on the glass tube was cuprite. I was unable at the time to make any quantitative determination of the various substances formed in this reaction, and am therefore not prepared to say what the reaction was precisely. Of course the iron pyrites was considerably attacked, but there was no separation of free sulphur; free hydrochloric acid was also present, but not in sufficient quantity to dissolve the small quantity of cuprite formed on the tube. The insoluble crystallised cuprous chloride was carefully washed in distilled water in order to free it from the substances already mentioned, then placed in another glass tube, covered with distilled water, and the tube sealed up and heated for seven days in an air-bath at temperatures varying from  $160^\circ$  to  $180^\circ$ . On the second day a very marked amount of a bright red substance had already formed on the sides of the tube, and here and there minute green spots of a substance somewhat resembling atacamite ( $\text{CuCl}_2 \cdot 3\text{CuHO} + x\text{H}_2\text{O}$ ) in colour. This tube was heated at the temperatures given for about two weeks, when it was observed that although the red deposit did not increase in quantity, the cuprous chloride was slowly undergoing decomposition, a black powder having separated out. On opening the tube a smell of hydrochloric acid was perceived. The liquid portion in the tube was poured out, and the solid portion (which principally consisted of unaltered cuprous chloride crystals with a little of the dark-coloured powder) well washed with water. By levigation it was easy to separate the powder from the crystals and to submit it to a further examination. In order to free it completely from cuprous chloride it was heated in a beaker with a solution of ammonium sulphate in water, which dissolved out all the cuprous chloride and left the powder intact; and the latter on being dissolved in nitric acid, did not give any reaction for chlorine, whilst the presence of copper was very evident; hence there is scarcely any doubt about this substance being cupric oxide. The liquid portion contained free hydrochloric acid and cupric chloride.

When the red deposit first commenced to form upon the sides of the tube a small quantity of violet-red crystalline cuprite was undoubtedly also present, but disappeared on the experiment being continued. I dissolved the red deposit in nitric acid and detected the presence of a large quantity of chlorine in the solution, also that of copper. Therefore I conclude that this red substance is the so-called cuprous oxychloride described by Wöhler (*Ann. Chem. Pharm.*, cxxx., 376). On exposing the substance to the air it takes up oxygen, and acquires a beautiful apple-green colour, becoming a cupric oxychloride which has probably the same composition as Atacamite.

*Chalcotrichite.*—Being desirous of ascertaining what the action of a moderately strong solution of sodium chloride in water would be upon pure artificially-prepared cuprous oxide when heated with it in a sealed tube, I employed the following method, viz.: The tube was heated in an air-bath for five days at a temperature varying from  $150^\circ$  to  $180^\circ$ , when small traces of a green substance (probably atacamite) were observed, the cuprous oxide had become dark brown in colour, and on the sides of the tube there were small beautiful radiating tufts of an orange-red coloured substance closely resembling the prismatic variety of cuprite called chalcotrichite. Continuing to

heat the tube, on the eighteenth day it was opened, when it was found that no further formation of the prismatic substance had taken place, but there was a beautiful deposit of highly crystalline violet-red coloured cuprite on the sides of the tube. The fibrous substance was dissolved in nitric acid (after having been boiled in distilled water for several hours and carefully washed) and tested for chlorine, which was found to be entirely absent, whilst copper was present in large amount; hence there can be no doubt that this prismatic substance was the rare mineral chalcotrichite. From this experiment it is evident that cuprous chloride was formed at first by the reaction between the sodium chloride and cuprous oxide, and this cuprous chloride was decomposed into cuprous oxide again and deposited on the sides of the tube as above described. I shall refer to the importance of the occurrence of chalcotrichite in conjunction with cuprite when I come to consider the origin of all the copper ores in a future paper, and will therefore describe another series of experiments having for their object the direct formation of malachite.

**Malachite.**—Great difficulty was experienced in carrying out these experiments for any length of time, owing to the frequent bursting of the tubes, due, no doubt, to their being somewhat weakened by the formation of silicates upon the surface of the glass. Pure artificially prepared cuprous oxide was placed in a glass tube and covered with distilled water, saturated with perfectly pure carbonic acid gas, and then sealed up and heated in the air-bath at a temperature varying from 150° to 175°. After heating fifteen days, the tube was opened and allowed to stand exposed to the air, when a thin film of malachite was observed coating the small clumps of suboxide here and there. The action of oxygen was found to be absolutely essential in the production of malachite by this method, there being no sign of any such formation in the tube before it was opened. Thus there can be no doubt that the greater part of the malachite formations have been produced by the action of water containing carbonic acid gas in solution upon cuprous oxide, as the malachite of the Gumeschewskoi Mine, near Ekaterinenburg, in Russia, is found deposited in a dark coloured clay which penetrates a small limestone ridge, the whole formation finally resting upon chloritic slate. I have examined numerous specimens of malachite from all parts of the world, and have always observed strong evidence of the action of water upon them, there being numerous cavities always present, which exhibit deposits of cuprous oxide, or hydrated ferric oxide in their interiors, and occasionally amorphous silica and calcite. Gustav Rose ("Mineralogische-geognostische Reise nach dem Ural, dem Altai, und dem Kaspischen Meere," 1837), was of opinion, after examining the copper formations in the Ural and Altai districts, that the cuprite there was formed by direct oxidation of the metal; and, secondly, that the large malachite deposits were formed from the cuprite. This opinion probably well expresses the actual process which eventually resulted in the formation of malachite, as the presence of the clay surrounding the ore, the limestone formation and the hydrated ferric oxide and hornstone (amorphous silica) shows that the former neighbouring crystalline rocks must have been submitted to the powerful action of water, which in all probability contained carbonic acid gas. Rose does not give (so far as I am aware) any experimental proofs of his theory of the formation of the great copper deposits of the districts above mentioned. I considered it therefore necessary to endeavour to determine experimentally the accuracy of his statement. For this purpose I placed perfectly clean polished strips of chemically-pure copper sheet in a glass tube, and covered them with distilled water saturated with carbonic acid gas; the tube was then sealed up and heated in a water-bath at 100° for some time. In three days I observed a decided formation of a film of cuprous oxide (which was crystalline) upon the metal; on the seventh day there were small particles here and there of a green

substance, which was undoubtedly a basic copper carbonate—very probably malachite. On continuing the heating of this tube for a few days longer at the same temperature, a considerable amount of cupric oxide was formed in scales, arising, doubtless, from the decomposition of the malachite, as it is a well-known fact that malachite on being boiled in water, decomposes into cupric oxide, carbonic acid gas, and water. In order to see what effect pure distilled water would have upon metallic copper under similar circumstances, I placed a large strip of clean polished sheet-copper in a tube, covered it with distilled water, and sealed the tube up, heating it in the water-bath as in the previous experiment. I was astonished to find on the third day that the copper was strongly coated with cupric oxide, so that it is evident that pure water has a greater chemical action as an oxidising agent than water containing carbonic acid gas. Having thus obtained the results described, I may be allowed to draw some conclusions from them, as regards the primary copper ore, and the eventual formation of the other ores from it, briefly as follows, viz.:—

1. In all probability the crystalline rocks contain disseminated throughout their mass extremely minute quantities of metallic copper (*when perfectly fresh*); Bischoff mentioning many rocks in which small quantities of cupric oxide have been detected, where its presence would never have been expected.

2. By the action of water, or a solution of carbonic acid gas in water, the metallic copper particles were converted *in situ* into one of the three following substances, viz., cuprous oxide, cupric oxide, and malachite.

3. By the action of water partially charged with sodium chloride (derived from the surrounding rock masses), cuprous chloride and cupric chloride were formed and carried down into the fissures below, where, by the action of a heat which need not have exceeded 160°, the cuprous chloride (for the cupric chloride would be completely reduced to cuprous chloride by the action of the iron pyrites which is universally present in all crystalline and metamorphic rocks) was decomposed into cuprite and cupric oxide and deposited in the fissures or lodes. The ferric sulphate simultaneously formed in the reduction of the cupric chloride would eventually decompose into hydrated ferric oxide and accompany the cuprite in the lodes, whilst the free hydrochloric acid formed in this process would readily attack the neighbouring rocks, thus causing the deposition of gelatinous silica in the lodes.

It will now be my next endeavour to study the chemical composition of all the rocks occurring in the immediate neighbourhood of copper mines, and particularly the evidences of decomposition of these rocks at the place of contact with the metalliferous lode, in order to ascertain whether the above conclusions are correct. In a future communication I hope to deal with the statement made by great authorities on this subject, that the sulphides of copper are the primary and oldest compounds of that metal.

## NOTICES OF BOOKS.

*Nature's Hygiene and its Artificial Imitation.* London Sanitas Company.

It is not often that a patented remedy or a prophylactic for any disease can come legitimately under our cognisance. In the pamphlet before us, however, and in the accompanying circulars, certain questions are raised which are of no small scientific importance. Is it, in the first place, an established fact that either the pine, or the eucalyptus, or the sunflower, or any other plant, has the power of rendering a district more healthy, and in particular of banishing zymotic disease? On this point there is a lamentable want of accord among those who have had

opportunity for personal observation. On the one hand we hear most satisfactory accounts of the sanitation of malarious districts in France, Italy, Portugal, Algeria, South Africa, and we believe also in Cuba; but just as we are on the point of admitting the virtues of the blue gum tree, as demonstrated, comes a witness on the other side, and tells us of malaria in Queensland, in the very heart of a eucalyptus forest, where the air is loaded with the supposed health-giving odour. Which of the observers is, then, under a mistake, or in which case did circumstances unknown or unrecognised interfere with the result?

As regards the pine the same discrepancy prevails. There are two villages in Silesia named See and Moholtz, situate in a rather narrow and swampy valley, girt in by heights covered with pine-woods. The resinous odour, during the summer months, is of the loudest; yet it would be difficult to find a spot in the temperate zone more scourged with dysentery. Would the disease be still worse if the pine-woods were cut away?

We have then, again, the case of camphor, which we read has for ages enjoyed an extraordinary reputation as an antiseptic, and which is "to this day worn by thousands of persons as a preservative against fever, cholera, and small-pox." We are perfectly well aware that camphor enjoys this reputation, but what are the precise facts upon which such reputation is founded? It is said to have the power of banishing or destroying low forms of organic life,—without which, indeed, it could not well act as a safeguard against zymotic disease; yet entomologists tell us that they have discovered mites under a lump of camphor, and that as a safeguard against these foes to museums it is far inferior to the oil of aniseed.

"It has been observed," says the writer, "that wooden hospitals are particularly efficacious as inducing rapid convalescence, a fact hardly susceptible of more than one explanation—that the resinous and turpentine-like bodies existing in the wood exhale under ordinary conditions gases grateful to the human organism." But resinous and turpentine-like bodies are by no means equally present in all woods. Is it not very possible that the superior ventilation, and the absence of accumulated malific matter in hastily extemporised wooden hospitals, may have something to do with the rapid convalescence in question?

In short, before explaining the "mysterious agency of certain plants and trees," would it not be well first to place beyond doubt the existence of such an agency, and to ascertain its conditions and limits?

We are next called upon to assist at the obsequies of ozone and the proclamation of its successor. Poor ozone! It has furnished employment to the thoughts of all classes of men, from learned physicians and profound chemists down to enterprising quacks, who have, as usual, had the best of the bargain. And now the truth has been gradually dawning upon us that ozone is, after all, not the great disinfectant, but rather a poison, and that its presence or absence in the atmosphere of any place stands in no decided relation to the sanitary character of the locality. In its stead reigns the compound called by mortals peroxide of hydrogen, but known among the gods as hydroxyl. Mr. Kingzett's merit is stated in the pamphlet to consist in "the identification of its purifying power (*i.e.*, that of peroxide of hydrogen) with that of the pine and the eucalyptus, and the invention of a method of preparation which brings it within the reach of the public." A few lines further we read that "Sanitas owes its disinfecting power to the peroxide of hydrogen, and its preservative power to the camphoric acid and other ingredients." But turning to a "testimonial" bearing the signature of Arthur Hill Hassall, M.D., we read, to our amazement, that "Sanitas consists of a solution of substances (!) capable of furnishing considerable quantities of the most powerful of all oxidisers, *namely ozone!*" Thus, unless we misunderstand the somewhat obscure language of the testimonial, our old

friend is risen again. Will no *Œdipus* tell the world plainly with which of the two, ozone or peroxide of hydrogen, we have here to deal? Of the latter compound, as present in the liquid, Dr. Hassall makes no mention.

In conclusion we may remark that if "Sanitas" fulfils even half the promises held out on its behalf, it has before it a triumphant future. An agent capable of fixing ammonia, of killing ferments, &c.,—and thus preserving wines, beer, and milk,—of destroying odours without injuring flavours, of bleaching glue and gelatine without affecting the colours of carpets, furniture, &c., of proving fatal to parasites, blight, and injurious insects without affecting vegetation, has not hitherto existed.

*A Guide to the Determination of Rocks, being an Introduction to Lithology.* By E. JANNETTAZ. Translated from the French, by G. W. PLYMPTON, Professor of Physical Science in the Polytechnic Institute, Brooklyn. New York: D. van Nostrand.

We have here a work calculated to be of great service to the geological student by assisting him in the recognition of the various rock-species which he may encounter, and thus putting him in the position to observe for himself—the only manner in which geology can be usefully studied.

The author's introduction contains some valuable information as to the examination of laminæ of rocks by the aid of polarised light.

In the first part we find a description of the leading mineral species which constitute rocks, with their crystallographic forms, illustrated by diagrams; their behaviour before the blowpipe, and other characteristic reactions.

In the second part the author passes to a consideration of the rocks made up of the minerals above mentioned, with their normal and their accessory elements, and their modifications. Thus under Granite we are told that, in addition to its well-known normal ingredients—felspar, quartz, and mica—it may contain talc, chlorite, hornblende, tourmaline, cordierite, albite, epidote, pinite, graphite, emerald, topaz, zircon, garnet, &c. "Andalusite" is, in our opinion, an orthographical error, the English name of the mineral being "andalusite."

The third part of the work describes the method to be followed in the practical determination of rocks. Having found by inspection, and by reference to characteristics laid down in earlier parts of the book, whether the specimen under examination belongs to the globuliferous, the cellular, the schistose, the vitreous, &c., class, further examination is instituted. Thus in the globuliferous class the procedure is as follows:—

- I. *With grains harder than steel.*
  - A. With vitreous globules { 1. Radiated texture.
  - B. With crystalline globules { 2. Splintery texture.
  - C. With irregular grains without intermediate matter.
  - D. Globules forming masses irregularly rounded.
- II. *With grains softer than steel.*
  1. Effervescing in HCl. No magnetic bead on charcoal.
  2. Effervescing in HCl. Giving magnetic bead.
  3. Not effervescing in HCl. Giving magnetic bead.
  4. No effervescence, and no magnetic bead.

These tables are then further carried out, until the enquirer is conducted to the name of the species sought. Thus the class—1. Having a radiated texture, includes—

- "In a vitreous paste, fusing to more or less hollow globules, white or grey (Spherulitic Obsidian).
- "Globules in a matrix resembling a tissue of glass threads, cellular, fusible (Pumice with Spherulites).
- "In a porous, subcrystalline, trachytic paste (Trachyte with Spherulites).

As an Appendix the author has added a "Dichotomic method for the Determination of Rocks," translated from

the "Cours Elementaire de Geologie Appliquée" of M. Stanislas Meunier.

The work may be decidedly recommended to students of geology.

*Principles of Theoretical Chemistry, with special reference to the Constitution of Chemical Compounds.* By IRA REMSEN, M.D., Ph.D., Professor of Chemistry in the John Hopkins University. London: Baillière, Tindall, and Cox. Philadelphia: H. C. Lea.

FROM the preface of this little work we extract the following passage:—"As for the value of the structural formulas which are discussed at some length in the second part of the book, it need only be said that if it be borne in mind what they are intended to represent, they are not quite so absurd as some chemists are just now trying to make us believe they are. These formulas certainly represent known facts in regard to the constitution of chemical compounds. They do not represent these compounds as a photograph, for example, represents a building, but rather somewhat in the same way that, in physics, lines represent forces in their magnitude and direction. Take the formulas for what they are and they have considerable value. Try to find in them the architectural plan of the chemical molecules and they appear absurd. But it is very unjust to find fault with a thing for not doing what it never pretended to do, and what its originators have distinctly stated it could not do."

This vindication of structural formulæ, which in substance we have often met with before, always reminds us of the apologies for image-worship offered by many good men, e.g., among the Brahmins. "We don't," say they, "worship the wood or the stone, but merely use it to give a stimulus and a right direction to our devotions." The misfortune is that such nice distinctions, whether theological or chemical, are gradually but surely lost sight of. The eminent men who first introduced structural formulæ certainly never contended that they were thus giving a ground-plan of a molecule as it would appear if we were able to see and to distinguish the atoms of which it consisted. But is not the very word "splitting up" (*abspaltung*)—now so generally introduced as a synonym for decomposition—in itself a proof that their original limitation is being disregarded, and that the formula, instead of merely pointing out the directions of affinity between the elements of a compound, is rapidly coming to be regarded as something more? Without at all endorsing the views of Prof. Kolbe, who regards structural formulæ as a mere frivolous amusement (*spielerei*), we cannot help fearing that there is sometimes too free scope given to the imagination, and that assumptions are made whose demonstration might not be easy.

The first part of the work before us is devoted to a "general discussion of atoms and molecules." Of this the most interesting part is the section which treats of the properties of the elements as functions of their atomic weights. Under this head we find a very fair account of the "periodic law" of Mendelejeff, and of the classification of the elements founded thereon. Lothar Meyer's tabular arrangement of the elements (see *Annalen der Chemie und Pharmacie*, 7 suppl., 356) is also quoted, but the author does not enter upon an explanation of its principles. He very justly declares that an accurate determination of the atomic weights is a necessary preliminary before such speculations as those of Mendeleeff and Meyer can bear their legitimate fruit, or can even be capable of verification. We think, however, that the number of atomic weights which he gives as having been thus strictly ascertained is somewhat larger than is laid down on page 11.

On the question of atomicity or valence of the elements we find the author rejecting the idea of variable valence on the ground that it ascribes "to the atoms themselves creative power and the power to annihilate energy." At the same time, in his final conclusions, he lays down this

proposition, that "valence is a fixed property of elements," which may be fully exerted or not." The distinction between this idea and the one just repudiated is scarcely as clear as might be desired. In the one case we have power variable, in the other power varying.

The second and larger portion of the book treats of the "Composition or Structure of Chemical Compounds," and contains views with which our readers are of course perfectly familiar.

## CORRESPONDENCE.

### ON THE MOTIONS OF CAMPHOR ON THE SURFACE OF WATER.

*To the Editor of the Chemical News.*

SIR,—In the CHEMICAL NEWS, vol. xxxvi., p. 215, there is a communication from Mr. Tomlinson on the above subject. From it I have learned that in my paper (vol. xxxvi., p. 191) I have "adopted a theory that has more than once been abandoned," and that I "neglect the true theory," which is the theory of Mr. Tomlinson. My views, then, are not orthodox, according to the definitions which I believe we owe to Mr. Carlyle:—Orthodoxy is *my* doxy, heterodoxy is *your* doxy.

It really matters very little whether this is the case; the only thing of importance is whether the facts that I have published are facts, and whether they lead to the conclusions that I have adopted. The accuracy of the facts themselves can be easily ascertained by any one who will take the trouble, and no knowledge of chemistry is necessary for this purpose.

Let any one place a few small pieces of camphor on water held in a glass, and provide himself with a glass rod, a stick of sealing-wax, and a piece of flannel. To avoid misinterpretations the glass, sealing-wax, and flannel should be made as clean as possible, as otherwise we may open a door into the regions of contractile forces and surface tensions.

Let us suppose that the pieces of camphor remain at rest on the surface of the water. The operator may then rub his stick of sealing-wax and dip it in the water, when the pieces of camphor will immediately begin to gyrate. If this does not happen, the sealing-wax should be wiped dry, rubbed with flannel, and again dipped in the water, when the motions will begin. Under very unfavourable conditions it may happen that the motions will only begin after repeated immersions of the sealing-wax. If, now, the operator will take his glass rod and excite it with flannel he will, by dipping his rod in the water, succeed in arresting the motions. If, after the motions are arrested, he continues to use his glass rod, the motions will begin again, and these motions caused by glass may be arrested with the stick of sealing-wax.

Keeping in view these simple experiments, can anyone say that electricity is not responsible for these motions of camphor? If not, then by rubbing glass and shellac with flannel we do not produce electricity. Does it really matter whether one person or twenty persons have written that these motions are not due to electricity, and whether the idea that they are "has been more than once taken and abandoned?"

I have no wish to lower the importance of surface tension, of contractile forces, of "the effluvium that escapes from camphor explosively after the manner of fire-works," and of other explanations from respectable sources. In relation to all these, however, I would point out that if we must suppose that these are the causes of camphor motion, the consequence of the facts that I have cited is that surface tension, contractile forces, &c., can be made to vary at the will of the operator who has control of a glass rod, a stick of sealing-wax, and a piece of flannel,

and therefore surface tension, and the rest are only indications of the electrical condition of the water surface. Phenomena arising from greasy fingers, ear-wax, and other dirt may have importance of their own, but have no direct bearing on the clear issue before us.

As Mr. Tomlinson wishes me to reconsider my statement concerning evaporation, I have no objection in doing this if it is clearly pointed out to me, in a definite manner, wherein I am wrong. I have no desire, nor do I suppose that Mr. Tomlinson has, of adhering to ideas that are proved erroneous. What I said of evaporation was that while I was trying to find why camphor moved on the surface of water at times, and at other times did not, I tried to determine the motions by heating the water, but without success, while on some days the camphor moved on the surface of ice water. From this I was inevitably led to the conclusion that the difference of the quantity of camphor evaporated was not the cause of the camphor moving at certain times and not at others.

Electricity solved the problem, and I adopted electricity. We all know, however, that the rate of evaporation affects the electrical condition of the water surface; therefore evaporation must necessarily have some influence on these phenomena.—I am, &c.,

P. CASAMAJOR.

Brooklyn, November 30, 1877.

#### DETECTION OF BISMUTH.

*To the Editor of the Chemical News.*

SIR,—Mr. Field's note on the detection of bismuth (CHEM. NEWS, xxxvi., 261), called forth by my remarks upon Von Kobell's test, draws attention again to the remarkably delicate process made known in 1862 by himself and Prof. Abel. Should there be any chemists who are still unacquainted with the reaction in question, they will have good reason to thank Mr. Field for again describing it in the CHEMICAL NEWS, as it is truly of most extraordinary delicacy. I did not allude to it when writing of Von Kobell's test and the suggested modification, not because I overlooked it, nor because I would for an instant suppose this latter to be as good, but, on the contrary, because I thought they did not come into any kind of comparison, and because their application is so totally different.

The blowpipe tests, even the very best of them, cannot, of course, compare at all with the "wet way," when really minute traces of metals are to be sought for. When I said of Von Kobell's test that it deserves to rank as one of the best—in some cases the best—test for bismuth, I meant that it very frequently renders any other and more elaborate process unnecessary. In less than a minute with cuprous iodide and aluminium plate, 0.1 per cent bismuth can be certainly detected in such substances as copper ores, regulus, &c., which do not contain too much lead or antimony using at most a decigramme of the powdered substance. In such cases I think the test may be spoken of as "the best," without in the least implying that there is none other more delicate when smaller amounts of bismuth are in question. Thus, 0.1 per cent is a perfect "heap" compared with the very minute amounts which can be detected by the method of Messrs. Abel and Field.

It is singular that neither the last edition of Fresenius (1874), nor of Rose (1867) contains any mention of this process, though I suppose they may be regarded as the completest and most authoritative works on qualitative analysis down to their respective dates.—I am, &c.,

W. M. HUTCHINGS.

Laboratory, Wallasey Ore Works,  
Birkenhead, December 20, 1877.

**New Battery with a Single Liquid.**—T. Jourdain.—The electrodes are zinc and graphite, and the liquid is an aqueous solution of the mixture known as glass-gall.—*Comptes Rendus.*

## CHEMICAL NOTICES FROM FOREIGN SOURCES.

NOTE.—All degrees of temperature are Centigrade, unless otherwise expressed.

*Comptes Rendus Hebdomadaires des Séances, de l'Académie des Sciences.* No. 23, December 3, 1877.

**Artificial Production of Corundum, Ruby, and various Crystalline Silicates.**—MM. E. Fremy and Feil.—The authors begin by forming a fusible aluminate and heating it to bright redness with a siliceous substance; the alumina is in this case slowly liberated from its saline combination in presence of a flux and crystallises. They attribute the crystallisation of the alumina to different causes, either to the reduction of this base by the gases of the furnace, or to the formation of a soluble silicate when the alumina is displaced by silica, or to a phenomenon of liquidation, which produces a very fusible silicate and sparingly fusible alumina. The displacement of alumina by silica seems the best method for effecting the crystallisation of the former earth. The authors place in a crucible of refractory earth a mixture of equal weights of alumina and red lead, and on calcining at bright redness for a sufficient time they find in the crucible, when cold, two distinct layers; the one is vitreous and consists of lead, the other is crystalline and often presents nodules filled with fine crystals of alumina. In this process the crucible acts by means of the silica which it contains. To avoid the loss of the product the authors generally use a double crucible. Colourless crystals of corundum are produced by the method just described, but the colour of the ruby may be obtained by adding from 2 to 3 parts of bichromate of potash, and that of the sapphire by using a small quantity of oxide of cobalt mixed with a trace of bichromate of potash. The crystals of ruby thus obtained are generally covered with silicate of lead, from which they have to be freed by prolonged heating in hydrogen and subsequent treatment with acids and alkalies. In certain cases crystals have been found almost pure and presenting all the characters of natural corundum and ruby. By the action of equal weights of silica and fluoride of aluminium kept at a red heat for several hours the authors obtain a silicate of alumina, agreeing in its composition and properties with dysthene, and on substituting boric acid for silica they produce a crystalline borate of alumina.

**Report on a Memoir by M. Hautefeuille on the Reproduction of Albite and Orthose.**—MM. Sainte Clair Deville, Des Cloizeaux, and Daubrée.—The process by which M. Hautefeuille has succeeded in the synthesis of albite and orthose consists in exposing the elements of these minerals, free or combined, to the action of melted tungstic acid or alkaline tungstates. Thus to form orthose a very basic silico-aluminate of potassa, containing 1 equivalent of alumina to 6 equivalents of silica was mixed with tungstic acid. If for potassa we substitute soda we obtain albite.

**Law of the Absorption of Radiations across Bodies, and of its Application in Quantitative Spectral Analysis.**—G. Govi.

**Battery in which the Electrode Attacked is of Charcoal or Coke.**—M. Jablochhoff.—The author fuses nitrate of potash or of soda and plunges into this, coke as attackable electrode, and as non-attackable, platinum or cast-iron. The latter electrode, made in the form of a pot, serves at the same time as a recipient for the melted nitre.

**Action of Oxalic Acid upon Sodium Silicate; Hydrated Quartz.**—E. Monier.—On pouring a weak solution of oxalic acid into silicate of soda in solution the two liquids do not mix, as there is immediately formed a siliceous layer of great resisting power, upon the upper

side of which crystals of oxalate of soda are formed. Upon prolonging the experiment the siliceous layer becomes thick and strong, and yields hydrated quartz harder than glass.

**On Certain Properties of Boric Acid.**—A. Ditte.—If melted and powdered boric acid is mixed with a small quantity of water,—say twice its weight,—the acid almost instantly increases in volume, becoming hydrated, whilst the temperature of the mixture rises to 100°. The crystalline acid in powder dissolves very rapidly in water with a fall of temperature; an equivalent of acid (62 grms.) at 15° absorbs 3187 calories in forming a solution almost saturated. If we add to the saturated solution half the quantity of water which it already contains, the fall of temperature on the dilution of the liquid is very slight, and corresponds to -241 calories per equivalent of acid dissolved. The specific heat of the hydrated acid is 0.353516. The specific gravity of the anhydrous acid is—

At 0° .. .. .	1.8766
12° .. .. .	1.8476
80° .. .. .	1.6988.

**Memoir on the Formation of Ultramarines, and their Colouration.**—E. Guinot.—On following the successive phases of the furnacing of ultramarine, as generally prepared at present, we observe various colours, which succeed each other in the following order:—Brown, green, blue, violet, red, white. These colours are the result of the progressive oxidation of the original mixture of materials. When the furnace containing the crucibles reaches a red-heat the sulphur melts, and produces immediately polysulphides with the sodium. The compounds thus formed present various colours, but they are so unstable in presence of air and water that they cannot be defined. They appear to owe their colouration exclusively to the sulphides which saturate the mass. The first stable product is the brown; it appears at the moment when, as the fire gets hotter, blue flames issue from the crucibles, indicating that the sulphur is becoming converted into sulphurous acid. When the flames cease to appear this transformation is completed, and if the crucible is then withdrawn from the furnace it is found full of a green substance. When the heat reaches 700° the blue begins to form. If the heating is now continued, allowing the air still to enter in excess as before, the product takes a violet shade, then red, or rather rose, and becomes ultimately white. This white ultramarine, if mixed with a little charcoal and heated to redness, reproduces red, violet, blue, green, or brown, according to the proportion of charcoal added. By prolonging the heating, and consequently the oxidation, any one of these products derived from the white ultramarine may be made to pass anew through the scale of changes,—the brown, for instance, being successively converted into green, blue, rose, and white. If for charcoal we substitute hydrogen, sal-ammoniac, or other reducing agent, the same results are obtained. These facts seem to indicate that the progress of colouration follows that of oxidation. The proof of this is found on the examination of the products obtained at different stages of the heating. Sulphur produces the colouration because if some other member of its group be substituted the ultramarine changes its colour. The soda, if it does not directly produce the colouration, is still necessary, since if any other substance is substituted the colouration of the product is hindered. Finally, ultramarine is not a unique compound; there are a whole series of ultramarines, some coloured (sulphur, selenium, and tellurium ultramarines), others colourless (potassic, calcic, and lithic ultramarines), and the study of these bodies may possibly throw a new light upon the chemical composition of the pigment.

**Modifications of Eggs, with Reference to a Memoir by MM. Béchamp and G. Eustache.**—U. Gayon.—The author points out that some of the conclusions of MM. Béchamp and Eustache were anticipated in his inaugural dissertation in 1875. From some of their other views he dissents.

## MISCELLANEOUS.

**South London School of Pharmacy.**—The Annual Dinner of this Institution was held at the "Horns" Assembly Rooms on Friday evening, December 21st; Dr. Muter in the chair. Dr. Julius Pollock presented the medals and certificates to the following successful competitors:—Senior Chemistry, Mr. Mortlock; Junior Chemistry, Mr. Heywood; Botany, Mr. Murdoch; Materia Medica, Mr. Hutton; Pharmacy, Mr. Mather.

## MEETINGS FOR THE WEEK.

TUESDAY, Jan. 1st, 1878.—Civil Engineers, 8.  
WEDNESDAY, 2nd.—Microscopical, 8.  
THURSDAY, 3rd.—London Institution, 7.  
FRIDAY, 4th.—Geologists' Association, 8.

**ERRATA.**—P. 261, col. 2, line 6 from bottom, for "although in the carbonates, atacamite, &c.," read "although in carbonates, atacamites, &c." P. 273, col. 1, for "Mr. John Mac'tear," read "Mr. James Mac'tear."

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